APPENDIX A

HYDROLOGIC MODEL MATRIX

Rainfall-Runoff Model Evaluation Matrix

		Model Network	rarameters Urban and Rural Applicability	Cost and Availability	Applicability and General Acceptance in Arizona	Operating Platform	FEMA Acceptance	Comments
Type	Rainfall-Runoff Model	-						
	HEC-1 4.0.1 and up	Unlimited	Applicable	Public Domain http://www.hec.usace.army.m il/software/legacysoftware/he c1/hec1-download.htm	Widely utilized in Arizona and applicable to existing Arizona methodologies	Dos-based. Available from a variety of vendors with enhanced features	Yes	
	HEC-HMS 1.1 and up	Unimited	Applicable	Public Domain http://www.hec.usace.army.m il/software/hec- hms/download.html	Applicable to existing Arizona methodologies	Window-based. Input/output file transfer not user- friendly in versions prior to 3.0.	Yes	Recently released version 3.0 (12/05) is in Java Language
	TR-20 Feb. 1992	Unlimited	Applicable	Public Domain but no longer supported by NRCS. http://www.wcc.nrcs.usda.gov /hydro/hydro-tools-models- tr20.html	NRCS methodologies applicable to Arizona. TR20 has been utilized in Arizona	DOS-based	Yes	
tnev3 elgni	TR-20 Win 1,00.002	Unlimited	Applicable	Public Domain http://www.wcc.nrss.usda.gov /hydroftydro-tools-models- wintr20.html	NRCS methodologies applicable to Arizona. TR20 has been utilized in Arizona	Windows-based	Yes	Computational procedure for estimating rainfall excess has been revised. These dranges have not been incoporated into HEC-HMS and perhaps other programs that include the NRCS Curve Nuber methodology
S	TR-55 June 1986	Limited to 10 subwatersheds	Primarily for small developed watersheds	Public Domain http://www.wcc.nrcs.usda.gov//hydro-tools-models-tr55.html	NRCS methodologies applicable to Arizona. TR55 has been utilized in Arizona	DOS-based	Yes	
·	Win TR-55 1.0.08	Unlimited	Primarily for small developed watersheds	Public Domain http://www.wcc.nrcs.usda.gov//hydro/hydro-tools-models-wintr55.html	NRCS methodologies applicable to Arizona. TR55 has been utilized in Arizona	Windows-based	Yes	Win TR-20 is the driving engine
	SWMM 4.30 and 4.31	Unlimited	Primarily developed for analysis of combined sewer overflows	Public Domain but no longer available from the EPA web- site	Though SCS methodology applicable to Aizona, program generally not utilized in Arizona.	D0S based	Yes	
· · · · · · · · · · · · · · · · · · ·	SWMM 5.0.005	Unlimited	Primarily developed for analysis of combined sewer overflows	Public Domain http://www.epa.gov/lednnmnt/ models/swmm/index.htm#Do wnloads	Some methodologies applicable to Arizona, program generally not utilized in Arizona.	Windows-based	Yes	·
	XP-SWMM 8.52 & up	Unlimited	Primarily developed for analysis of combined sewer overflows	Proprietary >\$5,000	Some methodologies applicable to Arizona, program generally not utilized in Arizona.	Windows-based with GIS interface	Yes	

	Unique Parameters		Develops release rate percentages	Snowmelt	Snowmelt		Snow accumulation and snowmelt are not simulated	Base flow, snowpack depth and water content, snowmeit, evapotranspriation, ground-water recharge, dissolved oxygen, biochemical oxygen demand (BOD), temperature, pesticides, conservatives, fecal coliforms, seaformed teachment and transport, seaforment coulting, by particle size, channel routing, reservoir routing, constituent routing, pH, ammonia, nitrite-nitrate, organic nitrogen, orthophosphate, organic phosphorus, phytoplankton, and zooplankton	Snowmelt	
	Diversions		Can divert and retrieve flow/ hydrographs	Can divert and retrieve flow/hydrographs	Can divert and retrieve flow/hydrographs	Unlimited diversions by computing flow splits for ponds with multiple outfalls	No information available	No information available	No information available	
Parameters	Runoff Translation		NRCS method	NRCS method	NRCS method	Available channel routing methods include Muskingum, Translation, and Modified Puls	Kinematic wave theory is used for both overland-flow and channel	rs developed from theory, instrumented watersheds	Channel flow is routed through the watershed channel system	
	Runoff Transformation		NRCS method	NRCS method	NRCS method	NRCS method	Kinematic wave theory is used for both overland-flow and channel	ds of process algorithm empirical relations fron	Surface runoff is routed over flow planes into channel segments	
	Losses		NRCS method	NRCS method	NRCS method	SCS Runoff CN method, Green-Ampt equation, Horton equation, initial and average infiltration rates, user-defined infiltration equations, and more	Green-Ampt equation	The model contains hundreds of process algorithms developed from theory, laboratory experiments, and empirical relations from instrumented watersheds	Distributed parameter modeling system	
	Rainfall		NRCS distributions	NRCS distributions	NRCS distributions	Unlimited number of synthetic or real storm events of any duration or distribution	Daily precipitation, daily evapotranspiration, and short interval precipitation are required.	HSPF uses continuous rainfall and other meteorologic records to compute streamflow hydrographs and pollutographs	Daily precipitation and daily maximum and minimum air temperature are required	
	Developed by		Penn State University	DHI Software (Denmark)	DHI Software (Denmark)	Bentley Geospatial	NSGS	NSGS	SSSN	
		Rainfall-Runoff Model	Penn State Urban Runoff Model (PSRM)	MIKE 11 UHM	MIKE 11 RR	PondPack v.8	DR3M	HSPF 10.10	PRMS Version 2.1	
		Type	fuev∃ €	elgni2		-		Confinuous		

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		Model Network	Urban and Rural Applicability	Cost and Availability	Applicability and General Acceptance in Arizona	Operating Platform	FEMA Acceptance	Comments
Type	Rainfall-Runoff Model							
fnev3 s	Penn State Urban Runoff Model (PSRM)	Unlimited. Network revisions/additions are tedious	Developed for urban areas	Obtained by attending a seminar at Penn State	SCS methodology applicable to Arizona. Program not utilizied in Arizona.	Orginally DOS based program now availble in a Windows based version	No	
əlgni2	MIKE 11 UHM	Unlimited	Applicable	Proprietary >\$18,000	Some methodologies applicable to Arizona, program generally not utilized in Arizona.	Windows-based	Yes	
	MIKE 11 RR	Unlimited	Applicable	Proprietary >\$18,000	Some methodologies applicable to Arizona, program generally not utilized in Arizona.	Windows-based	Yes	
	PondPack v.8	Unlimited	Primarily developed fro analysis of stormwater detention retention ponds	Proprietary, \$4000 to \$8000 depending on features	Some methodologies applicable to Arizona. Generally not utilized in Arizona.	Windows-based	Yes	
5	DR3M	A total of 99 flow planes, channels, pipes, reservoirs, and junctions may be used to define the basin	Primarily used to simulate small urban basins	Public Domain http://water.usgs.gov/cgi- bin/man_wrdapp?dr3m	Some methodologies applicable to Arizona. Generally not utilized in Arizona.	DOS-based	Yes	This is a continuous event model. Calibration to actual flood events is required.
suouniinoO	HSPF 10.10	No information available	HSPF simulates for extended periods of time the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well-mixed impoundments	Public Domain http://water.usgs.gov/cgl- bin/man_wrdapp?hspf	Some methodologies applicable to Arizona. Generally not utilized in Arizona.	DOS-based	Yes	HSPF is generally used to assess the effects of land-use change, reservoir operations, point or nonpoint source treatment alternatives, flow diversions,
	PRMS Version 2.1	No information available	Applicable	Public Domain http://water.usgs.gov/cgi- bin/man_wrdapp?prms	Limited applicability, generally not utilized in Arizona.	DOS-based	Yes	Modular-design, deterministic, distributed-parameter modeling system developed to evaluate the impacts of various combinations of precipitation, climate, and land use on streamflow, sediment yields, and general basin hydrology

APPENDIX B GENERAL SOIL SURVEY XKSAT VALUES

	STATSGO Map Unit	_ XKSAT	Rock Outcrop
ID	Name	in/hr	%
S274	Carrizo-Brios-Antho	0.96	0
S275	Rositas-Ripley-Indio-Gilman	0.23	0
S276	Denure-Dateland	0.25	0
S277	Glenbar-Gadsden-Brios	0.04	0
S278	Sasco-Marana-Denure	0.10	0
S279	Yahana-Indio-Gadsden	0.07	0
S280	Pahaka-Mohall-Laveen-Denure	0.51	0
S281	Momoli-Denure-Carrizo	0.69	0
S282	Why-Wellton-Gunsight-Growler-Denure	0.45	0
S283	Mohall-Denure-Coolidge	0.33	0
S284	Mohall-Contine	0.13	0
S285	Yahana-Shontik-Casa Grande	0.13	0
S286	Tremant-Pinamt-Ebon	0.06	0
S287	Suncity-Cipriano-Carefree	0.02	0
S288	Rillito-Gunsight-Denure-Chuckawalla	0.51	0
S289	Hyder-Coolidge-Cipriano-Cherioni	0.10	13
S290	Ligurta-Gunsight-Cristobal	0.17	0
S291	Pinamt-Gunsight-Cavelt	0.28	0
S292	Pinamt-Momoli-Cipriano	0.52	0
S293	Rock outcrop-Quilotosa-Momoli	1.00	30
S294	Rock outcrop-Quilotosa-Hyder-Gachado	0.25	15
S295	Schenco-Rock outcrop-Laposa	0.40	30
S296	Laveen-Kamato-Casa Grande	0.07	0
S297	Toltec-La Palma-Casa Grande	0.13	0
S298	Mohall-Dateland-Casa Grande	0.12	0
S299	Pahaka-Estrella-Antho	0.29	0
S300	Valencia-Estrella-Cuerda	0.28	0
S301	Superstition-Rositas	1.80	0
S302	Guest-Glendale-Gila	0.03	0
S303	Riveroad-Comoro-Arizo	0.21	0
S305	Mohave-Guest-Continental	0.06	0
S306	Tres Hermanos-Pajarito-Mohave	0.28	0
S307	Sonoita-Hayhook-Continental	0.47	0
S308	Sahuarita-Mohave-Cave	0.14	0
S309	Cacique-Bucklebar-Alko	0.08	0
S310	Stagecoach-Nahda-Delnorte-Agustin	0.27	0
S311	Pinaleno-Eba	0.03	0
S312	Nickel-Greyeagle-Continental	0.11	0
S313	Pinaleno-Palos Verdes-Nickel	0.14	0
0010	Tumarion-Rock outcrop-Lehmans-House Mountain-	- 0.11	Ū
S314	Akela	0.11	15
S315	Rock outcrop-Luzena-Faraway	0.07	25
S316	Rock outcrop-Lehmans-Gran	0.03	30
S317	Rock outcrop-Lajitas-Delthorny-Anklam	0.16	25
S318	Torriorthents-Rock outcrop	0.03	90
S319	Tovar-Toqui-Deama	0.23	0
S320	Santo Tomas-Pima-Comoro	0.26	0
S321	Hondale-Gothard-Bluepoint	0.20	0
S322	Sontag-Bonita	0.03	0
3022	Contag Donita	0.01	J

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	STATSGO Map Unit	XKSAT	Rock Outcrop
ID	Name	in/hr	%
S323	Tubac-Forrest-Enzian-Diaspar	0.10	0
S324	Winkel-Harrisburg-Cave	0.10	0
S325	White House-Hathaway-Bernardino	0.38	0
S326		0.08	0
	Tombstone-Stronghold-Jerag	0.37	•
S327	Torriorthents-Rock outcrop-Gypill	0.01	20
S328	White House-Hathaway-Caralampi-Bernardino	-	0
S329	Romero-Rock outcrop-Lampshire	0.32	31
S330	Zukan-Rock outcrop-Goblin	0.25	10
S331	Tanbark-Mellenthin-Calciorthids	0.10	0
S332	Thunderbird-Collbran-Boquillas	0.01	0
S333	Yumtheska-Natank-Disterheff	0.03	0
S334	Sponiker-Rock outcrop-Cross	0.03	10
S335	Rock outcrop-Mabray-Lemitar	0.21	15
S336	Pennell-Bacobi	0.34	0
	Tours saline-Sodic-Riverwash-Jocity saline-Sodic-		
S337	Ives saline-Sodic-Burnswick	0.07	1
S338	Marcou-Jocity saline-Sodic-Burnswick	0.09	1
S339	Wepo-Polacca-Jocity-Jeddito	0.13	2
S340	Sheppard sodic-Sheppard-Joraibi-Jocity	0.60	0
S341	Torriorthents-Tewa-Sheppard-Jeddito	0.23	6
S342	Rock outcrop-Moenkopie	0.29	50
S343	Nakai-Monue-Blackston	0.51	0
S344	Purgatory-Epikom-Claysprings-Badland	0.07	3
S345	Sheppard-Nakai-Monue	0.31	2
S346	Kinan-Hatknoll-Grieta	0.17	0
	Torriorthents-Sheppard-Pennell-Monue-Jocity-		
S347	Clayhole	0.12	0
S348	Pennell-Pagina-Kinan	0.47	0
S349	Mellenthin-Curhollow	0.32	0
S350	Yumtheska-Showlow-Lozinta	0.16	0
S351	Wayneco-Sazi-Rock outcrop-Rizno-Palma-Mespun	0.48	10
S352	Winona-Tenderfoot-Curhollow	0.21	0
S353	Rudd-Arches	0.43	0
S354	Poley-Palma-Clovis	0.02	0
S355	Winona-Tusayan-Boysag	0.28	0
S356	Rock outcrop-Needle-Epikom	0.42	26
S357	Sheppard-Palma-Hubert-Clovis	0.21	0
S358	Strych-Monue-Bison	0.28	0
	Spenlo-Schmutz-Redbank family-Palma family-		
S359	Naplene-Lavate-Ildefonso family-Clovis family-Caval	0.25	0
S360	Wupatki-Wukoki-Tuweep	0.16	0
S361	Stagecoach-Hindu	0.40	0
S362	Rock outcrop	0.19	80
S363	Sheppard-Grieta	0.19	0
S364	Ustic Torriorthents-Penistaja-Mido-Begay	0.21	7
S365	Milkweed-Deama-Cabezon	0.21	0
S366	Ubank-Cerrillos-Barx	0.11	5
S367	Rock outcrop-Mellenthin-Leanto-Kech-Bisoodi	0.30	30
S368	Nuffel-Kech-Barx	0.06	9
		_	

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STATSGO Map Unit	XKSAT	Rock Outcrop
ID Name	in/hr	%
S369 Rock outcrop-Deama	0.40	42
S370 Toqui-Topocoba-Deama	0.09	0
S371 Ziegler-Wilaha-Showlow	0.03	0
S372 Virgin Peak-Rock outcrop-Hualapai	0.03	15
S373 Moano-Barkerville	0.86	0
S374 Tortugas-Purner-Jacks	0.86	0
S375 Thunderbird-Rock outcrop-Luzena	0.23	15
S376 Typic Haplustalfs	0.02	0
S377 Thunderbird-Springerville-Rudd-Cabezon	0.23	0
S377 Whitlock-Continental-Cave	1.20	0
S379 Springerville-Cabezon	0.02	-
S380 Venezia-Thunderbird-Cabezon	0.02	0 0
	0.02	0
· · · · · · · · · · · · · · · · · · ·		-
S382 Lynx-Lonti-Balon	0.03	0
S383 Zyme-Tonalea-Kydestea	0.09	7
S384 Torriorthents-Badland	0.03	3
S385 Telephone-Rock outcrop-Overgaard-Elledge	1.00	10
S386 Spudrock-Elledge-Docdee	0.40	0
S387 Gordo-Baldy	0.40	0
S388 Sponseller-Ess	0.13	0
S389 Thunderbird-Showlow	0.01	0
S390 Typic Haplustalfs-Rock outcrop-Aridic Haplustalfs	0.32	20
S391 Typic Haplustalfs-Lithic Haplustalfs	0.14	0
S392 Sogzie-Sheppard-Rock outcrop-Aneth	1.70	10
S393 Shedado-Rock outcrop-Mespun-Begay-Anasazi	0.52	15
S394 Ustollic Haplargids-Rock outcrop-Namon	0.40	30
S395 Abreu	1.20	0
S396 Typic Eutroboralfs	0.40	0
S397 Typic Eutroboralfs	0.40	0
S398 Sheppard-Rock outcrop-Monue-Moepitz	1.74	10
S399 Pinamt-Momoli-Hickiwan-Gunsight-Denure	0.57	0
S400 Retriever-Calciorthids	0.25	0
S401 Vertic Haplustalfs-Aridic Ustochrepts	0.03	0
S402 Rock outcrop-Lama-Fragua	0.33	30
S403 Winona-Spudrock-Rock outcrop	0.40	10
S404 Winona-Spudrock-Rock outcrop	0.40	30
S405 Quintana	0.04	0
S406 Typic Paleboralfs-Eutric Glossoboralfs	0.40	0
S407 Typic Cryoboralfs-Rock outcrop-Eutric Glossoboralfs	0.06	20
S408 Rock outcrop-Eutric Glossoboralfs	0.75	30
S409 Typic Haplustalfs-Fluventic Ustochrepts	0.25	0
S410 Rock outcrop-Aridic Ustochrepts-Aridic Haplustolls	0.05	10
S411 Typic Paleboralfs-Typic Cryoboralfs-Rock outcrop	0.40	10
S412 Vertic Haplustalfs-Typic Haplustalfs	0.02	7
S413 Typic Haplustalfs	0.25	0
S414 Typic Haplustalfs	0.25	0
S415 Typic Haplustalfs-Rock outcrop-Eutric Glossoboralfs	0.32	20
S416 Silkie-Espiritu	0.04	0
S417 Wineg-Quintana-Amos	0.01	0

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	STATSGO Map Unit	XKSAT	Rock Outcrop
ID	Name	in/hr	%
S418	Typic Haplustalfs-Lithic Haplustalfs	0.13	0
S419	Mollic Eutroboralfs	0.40	0
S420	Rock outcrop-Mollic Cryoboralfs-Eutric Glossoboralfs	0.33	30
S421	Mirand-Derecho	0.12	0
S422	Silkie-Mirand	0.01	0
S423	Vibo-Casto	0.07	0
S424	Typic Haplustalfs-Mollic Eutroboralfs	0.16	0
S425	Mirand-Maes	0.10	0
S426	Eutric Glossoboralfs	0.40	0
S427	Heflin-Casto	0.06	0
S428	Rillino-Gila-Continental	0.37	0
S429	Tombstone-Romero-Rock outcrop	0.40	30
S430	Tubac-Pajarito-Hayhook-Glendale-Bucklebar	0.20	0
S431	Tres Hermanos-Pinamt-Artesia	0.17	0
S432	Eicks-Eba-Cloverdale	0.03	0
S433	Limpia-Graham-Bonita-Atascosa	0.04	0
S434	Mabray-Chiricahua-Atascosa	0.09	0
S435	Rock outcrop-Mokiak-Faraway	0.20	20
S436	Rock outcrop-Luzena-Fallsam	0.04	40
S437	Tapco-Peloncillo-Artesia	0.04	0
S438	Wampoo-Signal-Bonita	0.02	0
S439	Selevin-Eloma-Alsco	0.02	0
S440	Yumtheska-Virgin Peak-Rock outcrop-Katzine	0.37	22
S441	Rock outcrop-Piute-Bluechief	0.69	15
S442	Uzona-Shumbegay-Escavada	0.25	0
S443	Millett-Farview-Doakum	0.02	0
S444	Mido-Blanding-Arches	0.33	0
S445	Tunitcha-Klizhin-Akhoni	0.37	0
S446	Abreu	0.40	0
S447	Altar	0.40	0
S448	Altar	0.10	0
S449	Rock outcrop-Garr	0.10	40
S450	Ustorthents-Rizno-Metuck	0.17	0
S451	Vibo-Ustochrepts-Badland	0.17	0
S452	Telescope-Royosa-Augustine	0.17	0
S453	Badland-Aridic Ustochrepts-Aridic Haplustolls	0.17	0
S454	Shoegame-McNeal-Badland	0.07	0
S455	Rock outcrop-Lithic Ustorthents family-Hogris	0.13	30
S456	Torriorthents-Cellar	0.15	0
S457	Spudrock-Rock outcrop-Cellar	0.75	30
S458	Yaqui-Werlog	0.73	0
S459	Werlog-Santo Tomas-Riverwash	0.11	0
S460	Torriorthents	0.04	0
S461	Rock outcrop-Moenkopie	0.23	30
S462	Typic Ustifluvents-Fluventic Ustochrepts	0.40	0
S462 S463	Fluventic Ustochrepts-Aquic Ustifluvents	0.25	0
S463 S464	Vessilla-Rock outcrop	0.25	35
S464 S465	Teromote-Kopie	0.40	35 0
S465 S466	Quintana-Kopie	0.25	0
3400	Quintaria-Nopie	0.12	U

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	STATSGO Map Unit	XKSAT	Rock Outcrop
ID	Name	in/hr	%
S467	Typic Ustochrepts-Typic Haplustalfs-Rock outcrop	0.09	25
S468	Shoegame-Badland-Aridic Ustochrepts	0.07	0
S469	Ransect	0.04	0
S470	Typic Ustochrepts-Lithic Ustochrepts	0.04	0
S471	Typic Ustochrepts-Typic Haplustalfs-Rock outcrop	0.09	30
S472	Typic Dystrochrepts-Spudrock-Rock outcrop	0.18	30
S473	Typic Dystrochrepts-Dystric Cryochrepts	0.89	0
0170	Typic Dystrochrepts-Rock outcrop-Dystric	0.00	Ü
S474	Cryochrepts	0.10	20
S475	Dystric Cryochrepts	0.25	0
S476	Sobega-Quintana-Kopie	0.10	0
S477	Dystric Cryochrepts	0.25	0
S478	Rock outcrop-Lithic Ustochrepts	0.11	30
S479	Typic Dystrochrepts-Rock outcrop-Lithic Ustochrepts	0.18	30
S480	Quintana	0.04	0
S481	Spudrock-Sobega-Rock outcrop	0.40	40
S482	Spudrock-Rombo-Rock outcrop	0.05	30
S483	Timhus-Quintana-Flugle	0.09	0
S484	Riverwash-Prewitt-Lynx	0.14	0
S485	Ess-Cundiyo	0.40	0
S486	Hereford	0.04	0
S487	Vertic Argiborolls	0.04	0
S488	Pachic Udic Argiborolls	0.40	0
S489	Rock outcrop-Lithic Haplustolls	0.40	30
S490	Nakai-Monue-Blackston	0.51	0
S491	Ustochreptic Calciorthids	1.20	0
S492	Rock outcrop-Bond-Bidonia	0.07	15
S493	Winona-Pastura-Cibeque	0.30	0
S494	Sponiker-Godding	0.07	0
S495	Torriorthents-Calciorthids-Badland	0.02	0
S496	Faraway-Barkerville	0.82	0
S497	Tours-Showlow-Cibeque	0.03	0
S498	Rond-Jacks-Chevelon	0.05	0
S499	Tortugas-Roundtop-Rock outcrop	0.12	15
S500	Lemitar-Lampshire-Chiricahua	0.05	0
S501	Tuloso-Tinaja	0.23	0
S502	Riverwash-Prewitt-Pinetop-Lynx	0.08	0
S1126	Uzona-Rock outcrop-Myton family-Claysprings	0.41	55
S1129	Tecopa-Rock outcrop-Lithic Torriorthents	0.83	0
S1131	Rositas-Beeline-Badland	0.00	55
S1140	Rock outcrop	0.13	0
S1422	Rillito-Gunsight	0.02	10
S5061		0.05	0
S5065		0.19	0
	·	0.31	30
S5085	Udorthents-Rock outcrop	0.39	25
S5087	·	0.31	30
S5094	Udic Ustochrepts-Typic Ustochrepts	0.77	0
\$5065 \$5068 \$5085 \$5087	Typic Ustochrepts-Rock outcrop-Aridic Ustochrepts	0.19 0.31 0.39 0.31	0 30 25 30

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	STATSGO Map Unit	_ XKSAT	Rock Outcrop
ID	Name	in/hr	%
S5108	Fluventic Haploborolls-Aquic Ustifluvents	0.21	0
S5116	Typic Argiborolls	0.25	0
S5168	Rock outcrop-Flugle-Catman	0.05	13
S5169	Rock outcrop-Nogal	0.08	22
S5170	Teco-Rock outcrop-Montecito-Cabezon-Atarque	0.03	11
S5172	Stout-Kiln-Hesperus	0.27	0
S5173	Telescope-Royosa	1.48	0
S5177	Weska-Travessilla-Rock outcrop-Oelop	0.10	30
S5249	Ojocal-Alicia	0.07	0
S5315	Rock outcrop-Lehmans-Chiricahua-Chamberino	0.08	20
S5325	Rock outcrop-Muzzler-Luzena	0.04	20
S5331	Thunderbird-Rudd-Hubbell-Cabezon	0.06	0
S5333	Mion-Jacee-Goesling-Celacy-Augustine	0.03	3
S5396	Loarc-Guy-Dioxice-Datil	0.25	2
S5397	Manzano-Hickman-Catman	0.02	0
	Water-Virgin River-Toquop-Riverwash-Black Butte-		
S5573	Alluvial land	0.23	0
S5575	Naye-Mormon Mesa	0.74	1
S5576	St. Thomas-Rock outcrop-Kyler	0.31	15
S5577	Cave family-Cave-Ajo	0.43	0
S5578	Harrisburg-Cave-Arizo	0.23	0
S5579	Toquop-Black Butte-Arada	0.33	0
S5580	Tonopah-Colorock-Badland	0.32	0
S5581	Yurm family-Winkel-Torriorthents	0.13	9
S5586	Zeheme-St. Thomas-Rock outcrop	0.15	19
S5587	Zeheme-Virgin Peak-Rock outcrop-Hobog	0.22	14
S5588	Nickel-Bitter Spring-Arizo	0.16	2
S5589	Rositas-Pompeii-Gunsight-Carrizo-Ajo	0.14	0
S5590	Rock outcrop-Hindu-Gypill-Badland	0.03	25
S5592	Rock outcrop-Kanackey-Dedas-Calvista-Breko	0.03	20
S5742	Typic Torriorthents-Gypill-Cave-Badland	0.05	0
S7770	Sheppard-Rock outcrop-Oljeto-Neskahi-Mota	0.14	10
S7771	Rock outcrop-Piute-Moenkopie-Hoskinnini	0.06	20
S7774	Rock outcrop-Lithic Torriorthents-Badland	0.25	50
S8181	Tobler-St. George-Nikey-Junction-Harrisburg	0.30	0
S8182	Winkel-Renbac-Hobog-Bermesa	0.03	0
S8184	Shalet-Badland	0.28	5
S8187	Pastura family-Magotsu-Curhollow	0.21	5
S8196	Rock outcrop-Mespun-Arches	0.03	10
S8197	Yarts-Palma-Neville family-Barx-Atchee	0.13	5
S8198	Skos-Rock outcrop	0.04	20
S9582	Leanto-Bisoodi-Arntz	0.23	4
_	Torriorthents-Marcou-Claysprings-Burnswick-		
S9583	Badland	0.08	6
S9584	Strych-Rock outcrop-Monue	0.14	18
S9585	Vecont-Trix-Mohall-Denure-Dateland-Casa Grande	0.18	0
S9586	Selevin-Kimrose-Keysto-Caralampi	0.42	0

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APPENDIX C

INITIAL LOSS PLUS UNIFORM LOSS RATE

Initial Loss plus Uniform Loss Rate (IL+ULR)

In general, the Green and Ampt infiltration equation with an estimate of the surface retention loss should be used for most drainage areas in Arizona. The IL+ULR method should be used for drainage areas where soil texture does not control the infiltration rate (such as volcanic cinder) or where the soil texture of the drainage area is predominantly sand. Calibration data or results of regional studies are necessary to justify the selection of parameters for the IL+ULR method.

There are conceptual and computational differences between the Green and Ampt infiltration equation method and the IL+ULR method for estimating rainfall losses. When using the IL+ULR method, the initial loss (STRTL) is defined as the sum of surface retention loss (IA) plus initial infiltration loss that accrues before surface runoff is produced, and this is equivalent to initial abstraction. When using the Green and Ampt infiltration equation method, the initial abstraction is calculated based on the input of both the surface retention loss (IA) and the infiltration parameters (XKSAT, PSIF and DTHETA).

When using the IL+ULR method, both the initial loss (STRTL) and the uniform loss rate (CNSTL) must be estimated. Because this method is to be used for special cases where infiltration is not controlled by soil texture or for drainage areas and subbasins that are predominantly sand, the estimation of the parameters will require model calibration, results of regional studies, or other valid techniques. It is not possible to provide complete guidance in the selection of these parameters, however, some general guidance is provided.

- a. Because this method is only to be used for special cases, the uniform loss rate (CNSTL) will either be very low for nearly impervious surfaces or possibly quite high for exceptionally fast draining (porous) land surfaces. For land surfaces with very low infiltration rates, the value of CNSTL will probably be 0.05 inches per hour or less. For sand, a CNSTL of 0.5 to 1.0 inch per hour or larger would be reasonable. Higher values of CNSTL for sand and other surfaces are possible; however, use of high values of CNSTL will require special studies.
- b. The selection of the initial loss (STRTL) can be made on the basis of calibration or special studies at the same time that CNSTL is estimated. Alternatively, since STRTL is equivalent to initial abstraction, STRTL can be estimated by use of the SCS CN equations for estimating initial abstraction, written as:

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$$STRTL = \frac{200}{CN} - 2$$
 (3-2)

Estimates of CN for the drainage area or subbasin should be made by referring to various publications of the SCS, particularly TR-55. Equation 3-2 should provide a fairly good estimate of STRTL in many cases, however, its use will have to be judiciously applied and carefully considered in all cases.

Procedure

The following method can be used only when it is known that soil texture does not control infiltration rate. This method must be used with adequate calibration or verification to justify the use of uniform loss rates that may exceed the hydraulic conductivities shown in Table 3-4.

- 1. Prepare a base map of the drainage area delineating modeling subbasins, if used.
- 2. Delineate subareas of different infiltration rates (uniform loss rates) on the base map. Assign a land-use or surface cover to each subarea.
- 3. Determine the size of each subbasin and the size of each subarea within each subbasin.
- 4. Estimate the impervious area (RTIMP) for the drainage area or each subarea (Table 3-5).
- 5. Estimate the initial loss (STRTL) for the drainage area or each subarea by regional studies or calibration. Alternatively, Equation 3-2 can be used to estimate or to check the value of STRTL.
- 6. Estimate the uniform loss rate (CNSTL) for the drainage area or each subarea by regional studies or calibration.
- 7. Calculate the area weighted values or RTIMP, STRTL and CNSTL for the drainage area or each subbasin.
- 8. The area weighted values of RTIMP, STRTL and CNSTL for the drainage area or each subbasin are entered on the LU record of the HEC-1 input file.

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APPENDIX D

TIME-AREA RELATIONS

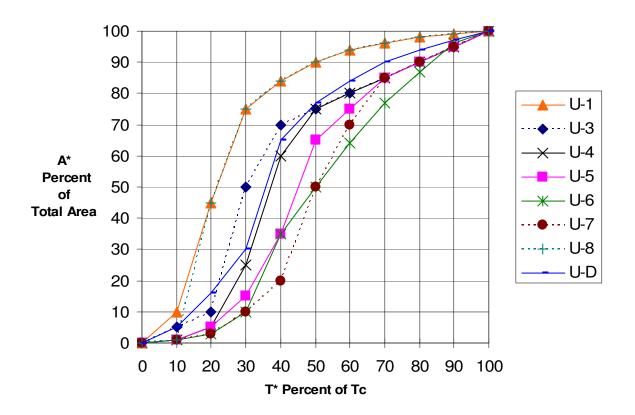
Time-Area Relations

The intent of providing the individual relations in addition to the generalized relation is to allow users the opportunity to select a time-area relation that was reconstituted from actual storm events for watersheds that might be similar to the watershed of interest. This selection would be based on similarities in location, drainage area, length and slope of the flow path, percent impervious and any other data that can be provided. If the user feels that there is not a good match of the watershed of interest to any specific time-area relation, then the generalized relations can be used.

- Figure 6 presents 7 different time-area relations reconstituted from runoff events on urban watersheds in Colorado, New Mexico, Wyoming and Arizona. The time-area relation identified as u-d is the composite relation adopted in the ADOT Manual
- Figure 8 presents 8 different time-area relations (exclusive of the HEC-1 default) reconstituted from runoff events on natural watersheds in Colorado, New Mexico, Wyoming and Arizona. The time-area relation identified as n-d is the composite relation adopted in the ADOT Manual.
- Table 2 lists the various watersheds considered in the reconstitution effort.
- Table 3 provides some of the watershed data/parameters for the watersheds. Column 16 of Table 3 is the link between the time-area relations presented in Figures 6 and 8 and the watersheds listed in Table 2.

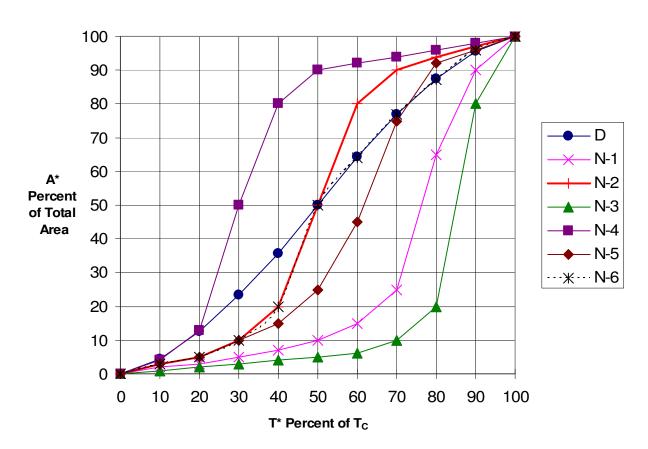
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FIGURE 6
Dimensionless Time-Area Relations for Urban Watersheds



T*	U-1	U-3	U-4	U-5	U-6	U-7	U-8	Default U-D
0	0	0	0	0	0	0	0	0
10	10	5	1	1	1	1	1	5
20	45	10	5	5	3	3	45	16
30	75	50	25	15	10	10	75	30
40	84	70	60	35	35	20	84	65
50	90	75	75	65	50	50	90	77
60	94	80	80	75	64	70	94	84
70	96	85	85	85	77	85	96	90
80	98	90	90	90	87	90	98	94
90	99	95	95	95	96	95	99	97
100	100	100	100	100	100	100	100	100

FIGURE 8
Dimensionless Time-Area Relation for Natural Watersheds



	HEC-1							Cor	nputed	Default
T*	D	N-1	N-2	N-3	N-4	N-5	N-6	WD	WMB	N-D
0	0.0	0	0	0	0	0	0	0	0	0
10	4.5	2	3	1	4	3	3	1	3	0
20	12.6	3	5	2	13	5	5	2	11	5
30	23.5	5	10	3	50	10	10	5	24	8
40	35.8	7	20	4	80	15	20	10	37	12
50	50.0	10	50	5	90	25	50	20	50	20
60	64.2	15	80	6	92	45	64	50	61	43
70	76.8	25	90	10	94	75	77	80	73	75
80	87.4	65	94	20	96	92	87	90	84	90
90	95.5	90	97	80	98	96	96	95	95	96
100	100.0	100	100	100	100	100	100	100	100	100

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TABLE 2 Watersheds Used in the Reconstitutions

W	Watershed Code	Area (acres)	Eff. Imp. Area (%)	Recording	Raingages Non-recording	# of Events Analyzed	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Albuquerque	Villa del Oso	AVD0	33.3	16.4	1	0	2
Albuquerque		AAA	33.3 79.4	16.3	2	0 0	2
	Academy Acres Taylor Ranch	ATR	79.4 87.0	9.6	2	0	1
	La Cueva Arroyo	ALA	57.6	9.0	1	0	3
	Camino Arroyo	ACA	57.6 57.0	0	1	0	2
	N. Camino Arroyo	ANCA	134.4	0	1	0	2
	N. Gamino Arroyo	ANCA	134.4	U	I	U	2
Denver	116th Ave.	D116	170.0	13.3	3	0	2
	Villa Italia	DVI	77.0	82.0	1	0	1
	Concourse D	DCD	96.0	90.0	1	0	1
	Goose Creek	DGC	441.6	15.4	1	0	1
	Sand Creek	DSC	185.6	24.0	1	0	2
Tucson	High School	THS	576.0	11.3	4	1	2
	Arcadia	TAR	2240.0	10.9	7	3	4
	Railroad	TRR	1472.0	17.0	3	3	2
	Atterbury	TAT	3181.0	3.0	1	8	3
Walnut Gulch	W-4	4-	560.0	0	4	0	2
	W-8	8-	3830.0	0	17	0	2
	W-11	11-	2035.0	0	10	0	2
	W-15	15-	5912.0	0	15	0	1
	W-103	103-	8.3	0	1	0	2
	W-111	111-	143.0	0	2	0	3
Wyoming	W.F. Dry Chey. Ck	WCU	441.6	0	1	0	2
,g	W.F. Dry Chey. Trib.	WC	1184.0	0	1	0	2
	Dead Horse Ck.	WDH	979.2	0	1	0	1
	East Teapot Ck.	WET	3482.0	0	1	Ö	1
	Dugout CK.	WD	454.4	0	1	Ö	1
	Headgate Draw	WHD	2124.8	0	1	Ö	1
	Medicine Bow Trib.	WMB	1926.4	0	1	0	1

Number of watersheds = 28

Number of events = 51

TABLE 3
Summary of Flood Resconstitutions using Tucson Data

Wate	ershed	Eff. Imp.	Storm	Rain	Runoff	C) p	t	р	Lag	T _c	R	$R_{rec.}$	Comp	Time-	STRTL	CNSTL	Ouptut	Comment
Code	Area	Area	Event			Obs.	Comp.	Obs.	Comp.					Int.	Area			File	
	(acres)	(%)		(in)	(in)	(cfs)	(cfs)	(hr)	(hr)	(hr)	(hr)	(hr)	(hr)	(min.)		(in.)	(in/hr)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
THS1	576	11.3	13 Aug 80	1.9	0.67	360	322	0.83	1.03	0.43	0.14	0.57	0.43	2	U-1	0.48	0.57	Ø6	multiple peak hg.
* THS2	"	"	11-12 Sept 82	0.9	0.38	331	348	0.50	0.50	0.30	0.29	0.31	0.3	5	U-1	0.48	0.28	Ø4	. , .
TAR1	2240	10.9	1 Sept 71	1.5	0.41	1430	1231	1.25	1.25	0.90	1.49	0.15	0.39	5	U-7	0.91	0.42	Ø8	estimated peak
TAR2	"	"	23 Aug 82	1.1	0.12	360	357	0.92	0.92	0.75	1.04	0.25	0.35	5	U-7	1.00	0.52	Ø4	
* TAR3	"	"	11 Sept 82	1.0	0.25	461	443	1.50	1.50	0.84	0.80	0.58	0.43	5	U-7	0.83	0.44	Ø5	
* TAR4	"	"	11 Sept 82	1.3	0.54	867	823	0.83	0.83	0.81	0.71	0.6	0.54	5	U-7	0.62	0.32	Ø5	1" antecedent rain
* TRR1	1472	17	11-12 Sept 82	0.8	0.41	515	504	2.00	1.92	1.10	1.46	0.51	0.43	5	U-5	0.24	0.05	Ø7	.6" antecedent rain
* TRR2	"	"	2 Aug 82	1.0	0.30	350	341	2.50	2.50	0.89	0.88	0.71	0.61	10	U-5	0.52	0.26	Ø4	
* TAT1	3181	3	26 Sept 84	1.4	0.27	178	200	5.00	4.75	3.42	2.36	3.18	2.10	15	D	0.17	0.33	Ø3	
TAT2	"	"	11 Sept 82	1.4	0.35	325	392	1.75	2.00	-	0.26	2.71	1.80	15	D	0.48	1.06	Ø1	rejected (T _c)
TAT3	"	"	25-26 Sept 76	1.7	0.51	340	296	2.25	4.00	-	2.74	3.48	1.83	15	D	0.10	0.96	Ø1	rejected (rain)

TABLE 4
Summary of Flood Reconstitutions Using Denver Data

Watershed Code	Area	Eff. Imp. Area	Storm Event	Rain	Runoff		Q_P		t _P	Lag	T _C	R	R _{rec.}	Comp. Int		STRTL	CNSTL	Output File	Comment
3343		7				Obs.	Comp.	Obs.	Comp.	•				••••••••••••••••••••••••••••••••••••••	7			•	
	(acres)	(%)		(in)	(in)	(cfs)	(cfs)	(hr)	(hr)	(hr)	(hr)	(hr)	(hr)	(min)		(in)	(in/hr)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
D116 1 D116 2	170.0 170.0	13.3 13.3	03-Jun-81 22-Aug-81	0.93 0.33	0.36 0.15	123 28	131 -	0.50 0.27	0.50	0.21	0.08	0.27	0.18	2	U-1 -	0.61 -	0.23	Ø3 -	rejected (rain)
*DVI 1	77.0	82.0	20-Apr-80	0.54	0.47	77	70	0.58	0.57	0.20	0.14	0.18	0.10	2	D	0.74	0.15	Ø4	
DCD 1	96.0	90.0	01-Aug-76	1.97	1.78	285	253	0.67	0.63	0.24	0.18	0.21	0.20	2	D	1.62	0.46	Ø2	
*DGC 1	441.6	15.4	25-Jul-76	0.86	0.30	137	129	0.75	0.75	0.63	0.71	0.35	0.32	5	D	0.61	0.04	Ø3	
DSC 1 *DSC 2	185.6 185.6	24.0 24.0	30-Jul-74 01-Aug-76	1.38 1.30	0.52 0.42	251 196	255 219	0.42 0.42	0.43 0.40	0.14 0.15			0.16 0.18		U-1 U-1	0.74 0.95	1.33 0.55	Ø4 Ø2	rejected (T _c)

APPENDIX E

PROCEDURE TO ESTIMATE MANNING'S ROUGHNESS COEFFICIENT

Procedure for Estimating n

The n for a channel can be computed by:

$$n = (n_0 + n_1 + n_2 + n_3 + n_4) m_5$$

The values for n_0 is the base value for a straight, uniform, stable channel, n_1 is a value for the effect of surface irregularities, n_2 is a value to account for obstructions to flow, n_3 is a value for vegetation, n_4 is a value to account for variations in channel cross section, and m_5 is a correction factor to account for meandering of the main channel.

The value for n_0 can be selected from Table D-1. The adjustment factors (n_1 , n_2 , n_3 , n_4 and m_5) can be selected from Table D-2.

For overbank floodplains, the value of n is selected from Table D-3. The Manning's roughness coefficient for the main channel is designated as ANCH, for the left overbank it is ANL, and for the right overbank it is ANR according to HEC-1 nomenclature.

TABLE D-1
BASE VALUES (n₀)OF MANNING'S ROUGHNESS COEFFICIENT FOR STRAIGHT, UNIFORM, STABLE CHANNELS

(from Thomsen and Hjalmarson, 1991)

	Size of Bed	l Material	Base Values, n ₀			
Channel Material	Millimeters	Inches	Benson and Dalrymple (1967) ^a	Chow (1959) ^b		
Concrete			0.012-0.018	0.011		
Rock Cut				.025		
Firm Soil			.025032	.020		
Coarse Sand	1-2		.026035			
Fine Gravel				.024		
Gravel	2-64	0.08-2.5	.028035			
Coarse Gravel				.028		
Cobble	64-256	2.50-10.0	.030050			
Boulder	>256	>10.0	.040070			

^aStraight uniform channel.

^bSmoothest channel attainable in indicated material.

TABLE D-2 ADJUSTMENT FACTORS ($n_1,\,n_2,\,n_3,\,n_4$ and m_5) FOR THE DETERMINATION OF OVERALL MANNING'S n VALUE

(from Thomsen and Hjalmarson, 1991)

Channel Conditions Degree of irregularity:	Manning's n Adjustment ^a n ₁	Example
Smooth Minor	0.000 .001005	Smoothest channel attainable in given bed material. Channels with slightly eroded or scoured side slopes.
Moderate Severe	.006010 .011020	Channels with moderately sloughed or eroded side slopes. Channels with badly sloughed banks; unshaped, jagged, or irregular surfaces of channels in rock.
Effects of obstruction Negligible	n ₂ .000004	A few scattered obstructions, which include debris deposits, stumps, exposed roots, logs, piers, or isolated boulders, that occupy less than 5 percent of the cross-sectional area.
Minor	.005015	Obstructions occupy 5 to 15 percent of the cross-sectional area and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction. Smaller adjustments are used for curved smooth-surfaced objects that are used for sharpedged angular objects.
Appreciable	.020030	Obstructions occupy from 15 to 50 percent of the cross-sectional area or the space between obstructions is small enough to cause the effects of several obstructions to be additive, thereby blocking an equivalent part of a cross section.
Severe	.040060	Obstructions occupy more than 50 percent of the cross-sectional area or the space between obstructions is small enough to cause turbulence across most of the cross section.

^a Adjustments for degree of irregularity, variations in cross section, effect of obstructions, and vegetation are added to the base n value before multiplying by the adjustment for meander.

^b Conditions considered in other steps must not be reevaluated or duplicated in this section.

TABLE D-2 Continued ADJUSTMENT FACTORS (n₁, n₂, n₃, n₄ and m₅) FOR THE DETERMINATION OF OVERALL MANNING'S n VALUE

(from Thomsen and Hjalmarson, 1991)

	Manning's n	Formula
Channel Conditions	Adjustment ^c	Example
Vegetation:	n ₃	
Small	.002010	Dense growths or flexible turf grass, such as Bermuda, or weeds where the average depth of flow is at least two times the height of the vegetation; supple tree seedlings such as willow, cottonwood, arrow weed, or saltcedar, where the average depth of flow is at least three times the height of the vegetation.
Medium	.010025	Grass or weeds where the average depth of flow is from one to two times the height of the vegetation; moderately dense stemmy grass, weeds, or tree seedlings, where the average depth of flow is from two to three times the height of the vegetation; moderately dense brush, similar to 1- to 2-year old saltcedar in the dormant season, along the banks and to no significant vegetation along the channel bottoms where the hydraulic radius exceeds 2 feet.
Large	.025050	Turf grass or weeds where the average depth of flow is about equal to the height of vegetation; small trees intergrown with some weeds and brush where the hydraulic radius exceeds 2 feet.
Very Large	.50100	Turf grass or weeds where the average depth of flow is less than half the height of vegetation; small bushy trees intergrown with weeds along side slopes of dense cattails growing along channel bottom; trees intergrown with weeds and brush.
Variations in channel cross section:	n_4	
Gradual	.000	Size and shape of cross sections change gradually.
Alternating	.001005	Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.
Alternating	.010015	Large and small cross sections alternate frequently, or the main flow frequently shifts from side to side owing to changes in cross-sectional shape.

^c Adjustments for degree of irregularity, variations in cross section, effect of obstructions, and vegetation are added to the base n value before multiplying by the adjustment for meander.

Channel Conditions	Manning's n Adjustment ^d	Example
Degree of meandering ^e :	m ₅	·
Minor	1.00	Ratio of the meander length to the straight length of the channel reach is 1.0 to 1.2
Appreciable	1.15	Ratio of the meander length to the straight length of the channel is 1.2 to 1.5
Severe	1.30	Ratio of the meander length to the straight length of the channel is greater than 1.5.

^d Adjustments for degree of irregularity, variations in cross section, effect of obstructions, and vegetation are added to the base n value before multiplying by the adjustment for meander.

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^e Adjustment values apply to flow confined in the channel and do not apply where downvalley flow crosses meanders. The adjustment is a multiplier.

TABLE D-3
VALUES OF MANNING'S n for FLOODPLAINS

(from Thomsen and Hjalmarson, 1991)

Description	Minimum	Normal	Maximum
Pasture, no brush:			
Short grass	0.025	.030	.035
High grass	.030	.035	.050
Cultivated areas:			
No crop	.020	.030	.040
Mature row crops	.025	.035	.045
Mature field crops	.030	.040	.050
Brush:			
Scattered brush, heavy			
weeds	.035	.050	.070
Light brush and trees, in			
winter	.035	.050	.060
Light brush and trees, in			
summer	.040	.060	.080
Medium to dense brush, in			
winter	.045	.070	.110
Medium to dense brush, in			
summer	.070	.100	.160
Trees			
Dense willows, summer,			
straight	.110	.150	.200
Cleared land with tree			
stumps, no sprouts	.030	.040	.050
Same as above, but heavy			
growth of sprouts	.050	.060	.080
Heavy stand of timber, a few			
down trees, little			
undergrowth, flood stage			
below branches	.080	.100	.120
Same as above, but with			
flood stage reaching			
branches	.100	.120	.160

EXAMPLES

Sample Watershed Data

This Appendix contains sample hydrologic model data for four gaged watersheds in Arizona, specifically watersheds within one of the Flood Regions identified in State Standard 2-96 and/or the USGS report, Statistical Summaries of Streamflow Data and Characteristics of Drainage Basins for Selected Streamflow-Gaging Stations in Arizona Through Water Year 1996, Water-Resources Investigation Report 98-4225 (USGS, Selection of the sample watersheds is discussed in more detail in the Technical Supplement. The watersheds include Rye Creek above Tonto Creek near Payson, a moderately complex watershed with a drainage area in excess of 100 square miles; Cemetery Wash, an urbanized watershed in Tucson; Military Wash, a low elevation, desert/rangeland condition watershed located in the southwest corner of Maricopa County; and Campbell Blue Creek, a high elevation condition watershed located on the eastern edge of the Arizona in Greenlee and Apache Counties. Data for one watershed, Rye Creek is presented in the format of a Technical Data Notebook (TDN), representing a sample report for submittal to the Arizona Department of Water Resources (ADWR) and Federal Emergency Management Agency (FEMA) per State Standard SSA1-97.

TEST WATERSHED STUDY FOR RYE CREEK ABOVE TONTO CREEK

Prepared for:

Arizona Department of Water Resources 500 North Third Street Phoenix, Arizona 85004 602-417-2445

May 2006

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Table 4.5-1	Hydrologic Model Results E-1			

Section 1: Introduction

This report describes a hydrologic study performed on Rye Creek. The purpose of this study is to test selected assumptions on a gaged watershed within Arizona in order to help develop hydrologic modeling technical guidelines for use within Arizona. This study is a requirement of Section 2.2.6 of the scope of work for this project. The scope requires the study of 2 relatively simple and 2 moderately complex watersheds. Rye Creek is considered a moderately complex watershed with a drainage area in excess of 100 square miles. This report follows the outline of the ADWR 'Instructions for Organizing and Submitting Technical Documentation for Flood Studies' (TDN Manual).

Rye Creek is located within Gila County near Payson as shown on Figure 1, Location Map and Vicinity Map. The watershed area studied is located within all or part of the following Sections;

Township 8 North, Range 8 East, Sections 13, and 23-26.

Township 8 North, Range 9 East, Sections 1-24, and 26-33.

Township 8 North, Range 10 East, Sections 2-11, 13-18 and 23.

Township 9 North, Range 9 East, Sections 1-36.

Township 9 North, Range 10 East, Sections 3-10, 15-22, and 27-34.

Township 10 North, Range 9 East, Sections 12-14, and 21-36.

Township 10 North, Range 10 East, Sections 7-8, 16-22, 26-30, and 31-34.

This study consists solely of a hydrologic model of approximately 122.6 square miles tributary to a gage station located on Rye Creek, immediately upstream of the confluence with Tonto Creek. The HEC-1 computer program developed by the United States Army Corps of Engineers was used to model the watershed. The methodology used follows Green and Ampt procedures described within the Arizona Department of Transportation (ADOT) publication 'Highway Drainage Design Manual – Hydrology' (ADOT Drainage Manual). The results of the model show a peak estimated discharge of approximately 36,200 cfs at the gage station for the 100-year design runoff event.

Section 2: Study Documentation Abstract

Section	Section 2.1: General Information					
2.1.1	Community	Gila County, Unincorporated Areas				
2.1.2	Community Number	040028				
2.1.3	County	Gila				
2.1.4	State	Arizona				
2.1.5	Date Study Accepted	n/a				
2.1.6	Study Contractor Contact(s) Address Phone Internal Reference Number	Ian Sharp JE Fuller Hydrology & Geomorphology Inc. 1955 E. Grant Road, Suite 148 Tucson, Arizona 85745 520-623-3112				
2.1.7	State Technical Reviewer Phone					
2.1.8	Local Technical Reviewer Phone	n/a				
2.1.9	River or Stream Name	Rye Creek				
2.1.10	Reach Description	Above Tonto Creek				
2.1.11	Study type (Riverine, Alluvial Fan, etc.)	Riverine				
Section	2.2: Mapping Information					
2.2.1	USGS Quad Sheet(s) with original photo date & latest photo revision date.	033111 H4 – Reno Pass, 1965 034111 A3 – Gisela, 1974 034111 A4 – Mazatzal Peak, 1974 034111 A5 – Table Mountain, 1969 034111 B3 – Payson South, 1975 034111 B4 – North Peak, 1975				
2.2.2	Mapping for Hydrologic Study Type/Source Scale Date	USGS Quad Maps, 7.5'				
2.2.3	Mapping for Hydraulic Study Type/Source Scale Date Subcontractor (Aerial) Date of Aerial Mapping	n/a				

Section	2.3: Hydrology	
2.3.1	Model or Method Used (including vendor and version description)	HEC-1, Version 4.1, U.S. Army Corps of Engineers Green and Ampt methodology
2.3.2	Storm Duration	24-Hour
2.3.3	Hydrograph Type	Clark Unit Hydrograph
2.3.4	Frequencies Determined	100-year
2.3.5	List of Gages Used in Frequency Analysis or Calibration (Location, Years of Record, Gage Ownership)	09498870 – Rye Creek Near Gisela, AZ USGS Ownership 12/09/1965 – 09/30/1985
2.3.6	Rainfall Amounts and Reference	NOAA 14 data. See HEC-1 model for more information.
2.3.7	Unique Conditions and Problems	n/a
2.3.8	Coordination of Q=s (Agency, Date, Comments)	n/a
2.4: Hy	draulics	
2.4.1	Model or Method Used (including vendor and version description)	n/a
2.4.2	Regime	n/a
2.4.3	Frequencies for which Profiles Were Computed	n/a
2.4.4	Method of Floodway Calculation	n/a
2.4.5	Unique Conditions and Problems	n/a
Section Inform	2.5: Additional Study nation	
Item		Description / Discussion
n/a		n/a

Section 3: Survey and Mapping Information

3.1 – Field Survey Information

No field survey was performed.

3.2 - Mapping

The base maps used were digital USGS Quad Maps on the NAD 1983 UTM Zone 12N horizontal datum. These maps were originally obtained between 1965 and 1975 and have a contour interval of 40 feet. No additional aerial maps were obtained and vertical control was not verified.

Section 4: Hydrology

4.1 – Method Description

The hydrologic model follows methodology and procedures outlined in the ADOT Drainage Manual for developing HEC-1 models. The HEC-1 model for Rye Creek is labeled 'RYE.DAT' and was developed in May, 2006.

4.2 – Parameter Estimation

4.2.1 – Drainage Area Boundaries

Figure 2 shows the general watershed map along with the eight sub-watersheds. The Rye Creek watershed was delineated from the Rye Creek headwaters down to the USGS gage station as found on the described USGS 7.5' Quad Maps, above the confluence with Tonto Creek. Rye Creek is within the Tonto Basin and is located to the east and south of the watershed divide between the Tonto Watershed and Lower Verde Watershed (also called the Mazatzal Divide). The westernmost and northernmost watershed boundaries are located on this watershed divide. Additionally, a portion of the westernmost watershed boundary is situated on the Yavapai County and Gila County boundary. Payson is located north of the northernmost limit of the watershed along the Tonto and Verde divide. A portion of the southernmost watershed boundary is situated along the Maricopa County and Gila County boundary.

The hydraulically longest flow path is approximately 21 miles. The northern apex of the watershed is at an approximate elevation of 5,100 feet. The highest point of the watershed is located along the Mazatzal divide with an elevation over 7,900 feet. The terminus of the watershed is at an approximate elevation of 2,800 feet. Flow paths are generally well defined canyons along the western limits. The flow paths are less defined along the eastern limits with some sheet flow areas present. The available aerial maps do not clearly show the vegetation density within this watershed.

4.2.2 – Watershed Work Maps

Soils data is shown on Figure 3 and the watershed work map is included as Figure 4. This watershed contains many tributary streams and creeks and could potentially be subdivided into over 20 sub-areas. However, the scope of this project requires a simpler approach, therefore a total of eight sub-watersheds were delineated. These

sub-watersheds were delineated to be as homogenous as practicable. These sub-watersheds are labeled SA-1 to SA-8. Five concentration points along the main stem of Rye Creek were identified and are labeled C-1 to C-5. A total of four routing reaches were identified and are labeled R*, with the routed node label following the letter R (C-1 is routed with RC-1).

There are no land-use boundaries shown on Figure 4. The watershed is in natural conditions with the exception of roads, highways, and power lines. The hydrograph routing path is down Rye Creek as labeled on Figure 4.

4.2.3 – Gage Data

The USGS previously maintained a water stage recorder gage station on Rye Creek, just above the Tonto Creek confluence with a period of record from 1965 to 1985. The peak discharge recorded by this station was 44,400 cfs (09/05/1970). The USGS estimates a 100-year discharge of 35,400 cfs at this station.

4.2.4 - Statistical Parameters

This section is not included.

4.2.5 – Precipitation

Rainfall data was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The rainfall depths for each sub-watershed were determined based on the NOAA Atlas 14. The corresponding depth values were entered into the HEC-1 model in the PH card, up to the 24-hour depth. The 100-year, 24-hour depths range from a minimum of 5.14 inches to 5.96 inches. No detailed analysis relating the hypothetical model precipitation and distribution to historic record and statistical parameters was performed.

4.2.6 – Physical Parameters

Soils data was obtained from the National Resource Conservation Services (NRCS) State Soil Geographic (STATSGO) Database. The soils data was used to determine the Green and Ampt loss rate parameter values. The individual soil types bounded by each sub-watershed were determined. Following this, the values of soil moisture deficit (DTHETA), hydraulic conductivity (XKSAT), and the wetting front capillary suction (PSIF) were identified for each soil type. Values of DTHETA, XKSAT, and PSIF were then estimated for each sub-watershed based on the inclusion of each individual soil type. The value of XKSAT was adjusted for vegetative cover density, which was estimated at 30 percent. The surface retention loss (IA) was estimated based on a composite value of desert and rangeland flat slope and hill slope values. Although this watershed contains a relatively high degree of rock outcropping, these areas were not considered hydraulically connected to the outfall (RTIMP equals 0).

The time of concentration was estimated following the procedures outlined in the ADOT Hydrology Manual. The desert/mountain equation was used to estimate the time of concentration. Flow path lengths (Lc and Lca) and areas were measured from the basemaps in AutoCAD. The slope was simply measured along the longest flow path

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with the apex and outlet elevations used in the slope estimate. The Clark unit hydrograph storage coefficient was estimated based on the equation in the ADOT Hydrology Manual. The desert/rangeland synthetic time-area relationship was selected and entered into the HEC-1 model in the UA cards.

Table 4.2-1 summarizes the physical parameters for each sub-watershed modeled.

Table 4.2-1 – Physical Parameters Summary

		i abic ii	,	0.0a a		coro ourri	a. y		
Sub-	A	Тс	Time- Area	Storage C	IA	DTHETA	XKSAT (adjusted)	PSIF	RTIMP
Watershed	(sq.mi.)	(Hours)	Relation	(Hours)	(in)	(normal)	(in/hr)	(in)	(%)
Rye-1	36.05	3.78	D-R	1.89	0.25	0.25	0.44	4.1	0
Rye-2	12.19	1.85	D-R	0.79	0.25	0.25	0.34	3.7	0
Rye-3	8.64	2.32	D-R	1.46	0.25	0.25	0.32	3.6	0
Rye-4	9.29	2.39	D-R	1.62	0.25	0.25	0.40	3.9	0
Rye-5	13.81	2.01	D-R	0.71	0.25	0.25	0.32	3.6	0
Rye-6	13.93	1.81	D-R	0.74	0.25	0.25	0.38	3.9	0
Rye-7	10.62	2.02	D-R	0.90	0.25	0.25	0.38	3.8	0
Rye-8	18.04	3.06	D-R	1.44	0.25	0.25	0.31	3.5	0
	Note: D	D-R = Dese	ert-Rangela	and for Tim	e Area	Relation (d	limensionless	s)	•

4.3 – Problems Encountered During the Study

4.3.1 – Special Problems and Solutions

No special problems or solutions are discussed.

4.3.2 – Modeling Warning and Error Messages

Warning messages were found regarding the stability of the modified puls method routing at extreme discharges. The discharges are above those modeled, this warning was disregarded.

4.4 – Calibration

No adjustments were made to the watershed parameters in order to calibrate the model. The basic assumptions yielded a peak discharge relatively close to the gage values. Minor adjustments have been made to the model to calibrate the routing. The number of steps (NTSPS) value on the RS card was adjusted based on normal depth velocity estimates, routing length, and the time step, as discussed in the HEC-1 manual.

4.5 - Final Results

4.5.1 – Hydrologic Analysis Results

Table 4.5-1 lists the peak discharges at key locations for the modeled 100-year, 24-hour runoff event.

Table 4.5-1 - Hydrologic Model Results

	Iab	le 4.5-1 - r	1yarologic	Model De2	นแจ	
Node	Included Sub-areas	Basin Area	Peak Discharge	Time to Peak	Runoff Volume	Peak Discharge Per Area
	Sub-areas	(sq-ml)	(cfs)	(hr)	(ac-ft)	(cfs/ sq-ml)
SA-8	-	18.04	5,271	14.50	1,133	292
SA-7	-	10.62	4,188	13.67	598	394
C-1	SA-8, SA-7	28.66	7,902	14.17	1,731	276
RC-1	C-1	28.66	7,868	14.33	1,731	275
SA-6		13.93	6,283	13.50	780	451
C-2	RC-1, SA-6	42.59	11,901	13.75	2,511	279
RC-2	C-2	42.59	11,638	14.25	2,511	273
SA-5	-	13.81	6,703	13.58	853	485
SA-4	-	9.29	2,365	14.00	505	255
C-3	RC-2, SA-5, SA-4	65.69	18,948	14.00	3,869	288
RC-3	C-3	65.69	18,697	14.25	3.869	285
SA-3	-	8.64	2,669	14.00	533	309
SA-2	-	12.19	5,600	13.50	730	459
C-4	RC-3, SA-3, SA-2	86.52	24,519	14.17	5,133	283
RC-4	-	86.52	23,594	14.75	5,133	273
SA-1	-	36.05	6,739	15.08	1,821	187
C-5	RC-4, SA-1	122.57	30,100	14.83	6,954	246

4.5.2 – Verification of Results

The results have been verified against two sources. First, the gage data at the USGS lists an estimated 100-year peak discharge of 35,400 cfs. The peak discharge and drainage area were plotted on Figure 10-21 (Q-100 Data Points and 100-Year Peak Discharge Relation for R12) of the ADOT Drainage Manual. The results from this model land well within the scatter and slightly below the regression line.

Section 5: Hydraulics

There was no hydraulic study for this project. All of the hydraulic sections and subsections described within the TDN Manual are omitted.

Section 6: Erosion and Sediment Transport

There was no erosion and sediment transport study for this project. All of the erosion and sediment transport sections and subsections described within the TDN Manual are omitted.

Appendix E-1: References

E-1.1 Data Collection Summary

No previous studies were obtained.

E-1.2 Referenced Documents

- Arizona Department of Water Resources, 1997, Instructions for organizing and submitting technical documentation for flood studies: Flood Mitigation Section.
- NBS Lowry Engineers and Planners, and George V. Sabol Consulting Engineers, Inc., 1993, Highway drainage design manual hydrology, Final report: Arizona Department of Transportation.
- Pope, G.L., et al, 1996, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: U.S. Geological Survey.

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Appendix E-2: General Documentation and Correspondence

E-2.1 Special Problem ReportsNot applicable

- E-2.2 Contact (telephone) reports
- E-2.3 Meeting minutes or reports
- **E-2.4 General Correspondence**
- **E-2.5 Contract Documents**

Appendix E-3: Survey Field Notes

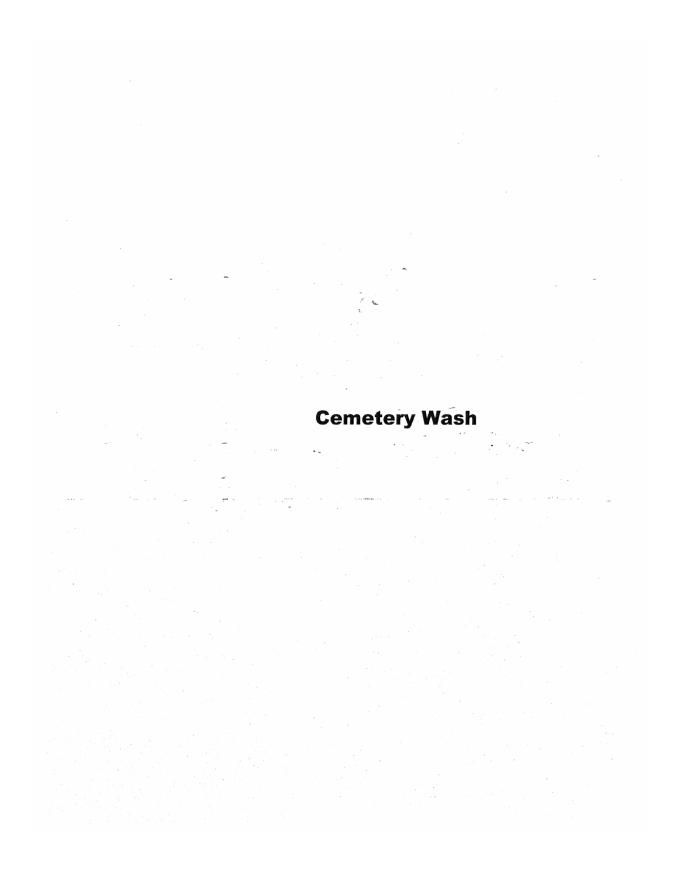
E-3.1 Survey Field Notes for Aerial Mapping Control Not applicable

E-3.2 Survey Field Notes for Hydrologic Modeling Not applicable

E-3.3 Survey Field Notes for Hydraulic Modeling Not applicable

Appendix E-4: Hydrologic Analysis Supporting Documentation

- E-4.1 Precipitation Data
- **E-4.2 Physical Parameter Calculations**
- E-4.3 Hydrograph Routing Data
- E-4.4 Reservoir Routing Data
- E-4.5 Flow Splits and Diversions Data
- **E-4.6 Hydrologic Calculations**



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	VOLUME (IN)	1.98			1.98					* * * * *							4-DAY 7-DAY
	TIME TO PEAK (MIN)	107.09	.2899E+02 BASIN STORAGE=	INTERVAL	107.00					***							2-DAY
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	т агрна	76.	- INFLOW=		76.	YDROGRAPH		(CFS) (INCHES) (AC-FT)	CUMULATIVE AREA	* * * *			OWL	NOFF DATA	CHARACTERI EA	TION DATA	
S N CA SHAPE W Z NDXMIN	BLEMENT	MAIN	MARY (AC-FT)		MAIN	ж * *	TIME	(IN)	СП	***	+ + + + + + + + + + + + + + + + + + +	* \$0200	*	SUBBASIN RUNOFF DATA	SUBBASIN CHARACTERISTICS TAREA .61	PRECIPITATION DATA	HYDRO-35 5-MIN 15-MIN .76 1.44
			NTINUITY SUM				PEAK FLOW	558		**	*	* 17 KK *			19 BA		8 PH
			CONTINUITY SUMMARY							***	***************************************	* *		SUBB			

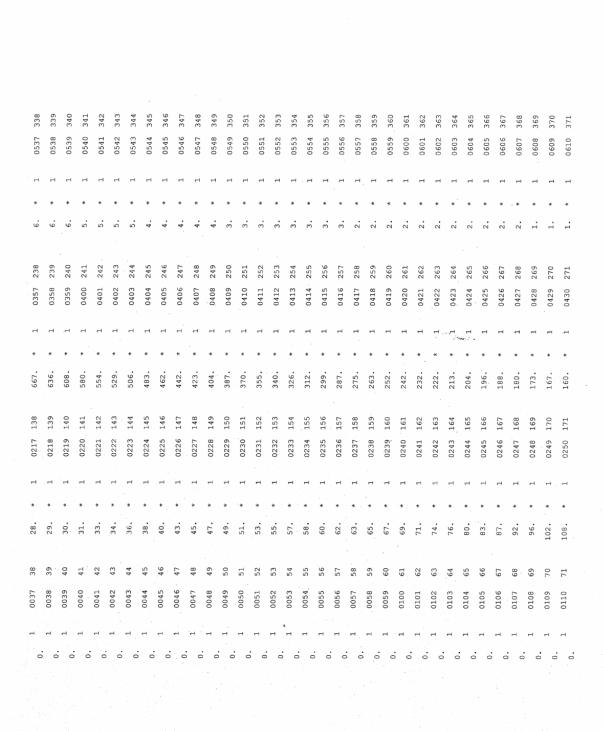
														* *			
		0.66												*			
		0.86				863. 626. 369. 208.	66. 37. 21.							***			
		0.96				865. 653. 391. 124.	70. 39. 22. 12.							* * * *			
		94.0			.29 HR	851. 680. 414. 233.	74. 42. 23. 13.							* * * *			
		0.06		00000 ET TO ZERO		APH ORDINATES 776. 709. 438. 247. 139.	44. 25. 14.	* * *		2.05	6.65-HR	121. 2.041 66.		* **			
A = .61 ION VITY AREA	ION	84.0	* *	EXCESS S	UNIT HYDROGRAPH PARAMETERS TC= .40 HR, R= TP= .15 HR, CP=	UNIT HYDROGRAPH 49. 739. 736. 736. 492. 464. 438. 277. 261. 139.	26. 15.			11	FLOW 72-HR	121. 2.041 66.		** * * *			
STORM AREA = STARTING LOSS MOLSYURE DEFICIT WETTING FROWTS SUCTION HYDRAULIC CONDUCTIVITY PERCENT IMPERVIOUS AREA	TIME OF CONCENTRATION STORAGE COEFFICIENT	11 ORDINATES .0 75.0		.01667 FOR PERIOD		09 END-0 499. 769. 277.	28. 16.	* *	80200	.72, TOTAL EXCESS	MAXIMUM AVERAGE FLOW 24-HR 72-HR	121. 2.041 66.	SQ MI	* * * * * * * * * * * * * * * * * * * *			
		20		01667 THAN ZERO	CLARK	328. 795. 518. 293.	52. 29. 17.						. 61	***			
AND AMPT LOSS RATE STRTL .12 DTH .35 PSIF 4.40 XKSAR 38 RTINP 52.00	РН .40 .29	REA VS. TI 10.0		DING LESS		173. 819. 543. 310.	31. 18.	* *	HYDROGRAPH AT STATION	2.77, TOTAL LOSS	6-HR	134. 2.041 66.	CUMULATIVE AREA =	* * * *			
	RK UNITGRAPH TC R	ACCUMULATED-AREA VS. TIME, 0 10.0 4		IN LOGLOG		838. 569. 329.	33. 19.	* *	HYDROC	2.77,		(CFS) (INCHES) (AC-FT)	CUMULAI	* * * * * * * * * * * * * * * * * * * *	****	N0200 *	***
GREEN	CLARK	ACCI		EDS TABLE		27. 853. 597. 348. 196.	62. 35. 20.			TOTAL RAINFALL =	TIME (HR)	1.72		* * * * * * * * * * * * * * * * * * * *	****	* N0200	k '
20 LG	21 UC	22 UA		VALUE EXCEEDS TABLE IN LOGLOG .01667 3.00000 WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO				* *		TOTAL 1	PEAK FLOW + (CFS)	1155.		***		24 KK	
					٠						+	+	-, -	*			

COMBINE SUBBASIN & CHANNEL HYDROCRAPHS @ NO200	ON 2 NUMBER OF HYDROGRAPHS TO COMBINE	**************************************	**************************************	T STATION NO200	MAXIMUM AVERAGE FLOW 6-HR 24-HR 72-HR 6.65-HR	192. 174. 174. 174. 2.024 2.024 2.024 2.024 95. 95. 95. 95.	EA = .88 SQ MI	水水水 水水水 含水水 水水板 花香香 化水板 机水板 机水板 机水板 化妆料 化妆料 化妆料 化妆妆 化水水 水水水 水水水 医水水 化妆妆 化妆妆 水水块 水水块					ROUTING HYDROGRAPH THROUGH CHANNEL R0250 IG DAWA	ERAM MOUTING 2073. CHANNEL LENGTH 2073. CHANNEL LENGTH 200 CONTRIBUTING AREA 3.00 CONTRIBUTING AREA 7FRAP CHANNEL SHAPE 50.00 BOTTOM WIDTH OR DIAMETER 50.00 SIDE SLOPE 2 MINIMUM NUMBER OF DX INTERVALS	COMPUTED KINEMATIC PARAMETERS VARIABLE TIME STEP (DT SHOWN IS A MINIMUM)	M DT DX PEAK TIME TO VOLUME MAXIMUM	$(MIN) \qquad (FT) \qquad (CFS) \qquad (MIN) \qquad (IN) \qquad (FPS)$	1.34 1.00 691.00 1675.67 107.68 2.03 10.50	.9542E+02 EXCESS= .0000E+00 OUTFLOW= .9551E+02 BASIN STORAGE= .1130E-02 PERCENT ERROR=	INTERPOLATED TO SPECIFIED COMPUTATION INTERVAL	1.34 1.00 1673.45 107.00 2.03
	26 HC HYDROGRAPH COMBINATION ICOMP		***	HYDROGRAPH AT STATION	PEAK FLOW TIME + (CFC) (HB)	1679. 1.75 (OFS) (AC-FT)	CUMULATIVE AREA =	古 化水石 放水板 化水子 化水石 化水子 水水石 化水石 化水子 化水子	*****	*	27 KK * R0250 *	****	ROUTING HYDROGRAPH ROUTING DATA	29 KK KINEMATIC WAVE STREAM ROUTING 1 2073 CHAN N 0.16 CHAN CA 0 CONT SHAPE TRAP CHAN WD 28 0.0 BOTT Z 50.00 SIDEM		ELEMENT ALPHA		MAIN 1.23	CONTINUITY SUMMARY (AC-FT) - INFLOM1		MAIN 1.23

(CPS) (190)

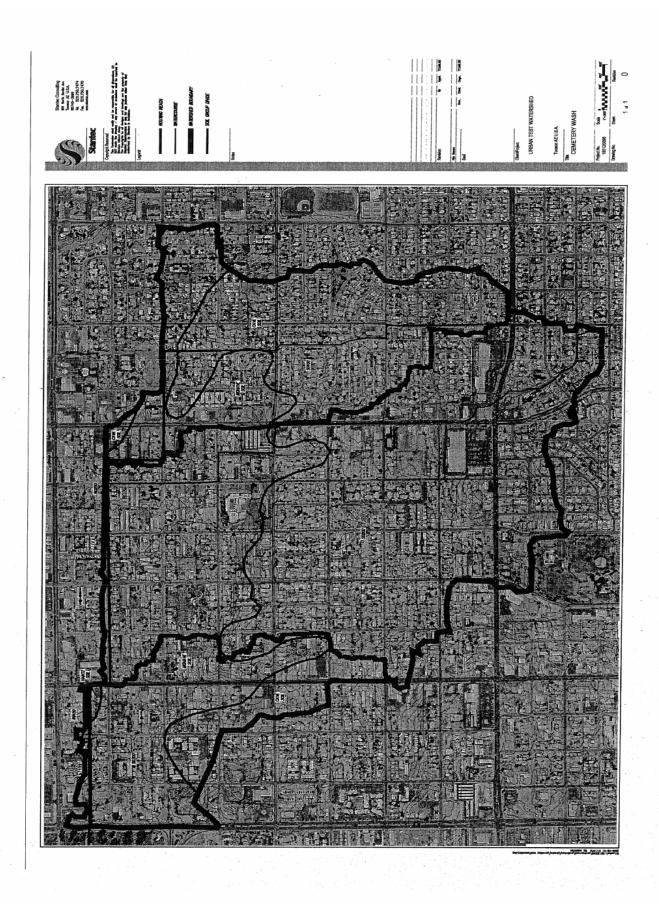
							***							安全有关的 计多元 医多克氏性 医克里氏性 医克里氏性 医克里氏性 医克里氏性 医克里氏性 医克里氏氏征 医克里氏氏征 医克里氏氏征 医克里氏氏征 医克里氏氏征 医克里氏氏征 医克里氏征 医克里氏征	I ORD	. 301	302
164. 74. 34. 15. 7.							* * * * * * * * * * * * * * * * * * * *						* * * * * * * * * * * * * * * * * * *	******	DA MON HRMN	1 0500	1 0501
178. 80. 36. 16. 7.							***						K K K K K K K K	****	FLOW *	43. *	40. *
193. 87. 39. 18. 8.							* * * * * *			•				****	ORD	201	202
209. 94. 19. 19.	* *		2.24	6.65-HR 39. 2.228			* * * * * * * * * * * * * * * * * * *		a N0300		BINE	**	N NO300 SRAPHS	****	DA MON HEMN	0320	0321
226. 102. 46. 21. 9.			ıı	39. 2.228 21.					COMBINE SUBBASIN & CHANNEL HYDROGRAPHS @ N0300	SCALE	PHS TO COMBINE	* * * * * * * * * * * * * * * * * * * *	HYDROGRAPH AT STATION N0300 SUM OF 2 HYDROGRAPHS	****	* *	* *	* * 7
243. 111. 50. 23. 10.	* *	80300	.54, TOTAL EXCESS	MAXIMUM AVERAGE FIGOW 24-HR 72-HR 39. 39. 39. 2.228 2.228 21.	.18 SQ MI	***			CHANNEL HYI	NTROL TROL PH PLOT SCA	NUMBER OF HYDROGRAPHS	****	HYDROGRAPH SUM OF	***	ORD FLOW		103 1807.
259. 120. 54. 11.	*		11		. 18	***			UBBASIN & (PRINT CONTROL PLOT CONTROL HYDROGRAPH PLOT		***	***	****	DA MON HRMN OF		0141 10
276. 130. 59. 26. 12.	*	HYDROGRAPH AT STATION	2.78, TOTAL LOSS	6-HR () 43. () 2.228	CUMULATIVE AREA	*** *** ***			COMBINE SU	T CONTROL VARIABLES IPENT 1 1 IPLOT 0 1 OSCAL 0. 1	MBINATION 2	****		****	* DA MC		
294 140 63. 29.	* *	HYDRO		(CFS) (INCHES)	CUMULA	***		*******N0300 *	* * * * * *	OUTPUT CONTROI IPRNT IPLOT QSCAL	HYDROGRAPH COMBINATION ICOMP	*****************		******	FLOW	. 0	
310. 152. 69. 31. 14. 6.			TOTAL RAINFALL =	(HR)		* * * * *		* * * * * * * * N	* * * * * * * * * * * * * * * * * * * *	TOO	HYD	****		*****	HRMN ORD	0000 1	
	*		TOTAL	PEAK FLOW + (CFS) + 449.		** ***	* * * *	37 KK		40 KO	39 HC	***	* * * * *	****	DA MON HRMN ORD FLOW	0.0	

0323
0324
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0353 1641. 1526. 1526. 1412. 1412. 11356. 1149. 1149. 1169. 11007. 963. 963. 963.



		************		0.0	6	88	24	396	92	. 74	393	392	11	390.	389	388	387	386	385	384	383	382	381	380	379	378	377	376	375	374	373	372
		* * * * *		0639 400	0638 399	0637 398	0636 397	0635 39	0634 395	0633 394	0632 39					0627 38																0611 37
		* * * *									_			_					_			_	, ,				_	_	_	_	_	_
		* * * *			*		*	*	*	*		*	*	*	*	*		*	*	*	*	*	*	*	*	*	. *	*	*	*	*	*
		**		•	.0	0	0	.0	.0		;	1.	1.		1.	1.	1.	1.	1	1.	1.	1.	; ;	1.	1.	;	1.	1.	1.	1	1:	1.
		****																						_				-				
		* * *		300	299	298	297	296	295	294	293	292	291	290	289	288	287	286	285	284	283	282		280			5 277	276	275	274		272
0.03-HK		* * * * *		0459	0458	0457	0456	0455	0454	0453	0452	0451	0420	0449	0448	0447	0446	0445	0444	0443	0442	0441	0440	0439	0438	0437	0436	0435	0434	0433	0432	0431
0 1		* * * *		П	П	Н	г	7	Н	1	1	7	1	1		1	1	1	1	1,	1	1	-	П	7	٦.٦	1	1	1	П	,,,,	4
YH .	MO.	* * *	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	* .	*	*	*	*	*	*	
JH-21	MAXIMUM AVERAGE FLOW	********************		45.	48	51.	54.	57.	61.	64.	. 89	71.	75.	. 78.	82.	85.	.68	92.	96	.66	103.	107.	110.	114.	119.	123.	128.	132.	137.	143.	148.	104
NH_F.	IUM AVI	* * *		200	199	198	197	196	195	194	193	192	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177	176	175	174	173	7/7
1	MAXIM	水水水水水水水水水水水水水水水水水水		0319 2	0318 1	0317 1	0316 1	0315 1	0314 1	0313 1	0312 1	0311 1	0310 1	0309 1	0308 1	0307 1	0306 1	0305 1	0304 1	0303 1	0302 1	0301 1		0259. 1	0258 1	0257 1	0256 1	0255 1	0254 1	0253. 1	0252 1	1620
		* * * *			1,	, , , ,		1	7						п	н	н		н	-		1		, ,	1		1		1	1	Η.	4
		* * * *	*	* * *	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	. *	*	*	*.	*	*	*	*	*	*	*	
(CES)		***		1489.	1370.	1236.	1090.	949.	820.	701.	603.	518.	449.	398.	356.	323.	294.	270.	250.	233.	218.	205.	193.	182.	172.	163.	154.	146.	138	130.	121.	
(HR)	TIME	**		100	66	86	26	96	95	94	93	95	91	06	68	88	8.1	. 98	82	84	83	82	81	80	19	78	77	94	75	7.4	73	1
, -		*************		0139	0138	0137	0136	0135	0134	0133	0132	0131	0130	0129	0128	0127	0126	0125	0124	0123	0122	0121	0120	0119	0118	0117	0116	0115	0114	0113	0112	
(CFS)	PEAK FLOW	* * * * * *		, , , , ,			1	1	1		, П	7	1	1	1	1		1	, ,	, , , , ,	, ,			н.	1		ं , ल	, ,	Н	, ,		
٥	PEA	* * * * *		. 0																				. }				. , ,				

			TIME OF MAX STAGE												ENT ERROR=		ENT ERROR=			
			MAXIMUM STAGE									VOLUME	(IN)	1.98	.2899E+02 BASIN STORAGE= .5602E-03 PERCENT ERROR=	2.03	.1130E-02 PERCENT ERROR=			
			BASIN	.27	.27	.61	88	.88	.18	1.06	ING	ATED TO I INTERVAL TIME TO PEAK	(MIM)	107.00	STORAGE= .56	107.00	STORAGE= .11			
		D MILES	MUM PERIOD 72-HOUR	53.	53.	121.	174.	174.	39.	213.	SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING (FLOW IS DIRECT RUNGE WITHOUT BASE FLOW)	COMPUTATION THE TO VOLUME DT PEAK THE TO PEAK PEAK PEAK PEAK PEAK PEAK PEAK PEAK	(CFS)	558.08	E+02 BASIN	1673.45	.9542E+02 EXCESS= .0000E+00 OUTFLOW= .9551E+02 BASIN STORAGE=			
117.		MARY PER SECONI IN SQUARE 1	W FOR MAXII	53.	53.	121.	174.	174.	39.	213.	- MUSKINGUR WITHOUT BA	DT	(MIN)	1.00	FLOW= .2899	1.00	FLOW= .9551			
117.		RUNOFF SUN CUBIC FEET URS, AREA	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR 24-HOUR 72-HOUR	58.	. 58.	134.	192.	193.	43.	236.	MATIC WAVE	VOLUME	(II)	. 1.98	.0000E+00 OUTFLOW=	2.03)00E+00 OUT			
117.	1.06 SQ MI	RUNOFF SUMMERY FLOW IN CUBIC FEET PER SECOND TIME IN HOURS, AREA IN SQUARE MILES	TIME OF PEAK	1.68	1.78	1.72	1.75	1.78	1.65	1.78	RY OF KINEN FLOW IS DIE	TIME TO PEAK	(MIM)	107.09	EXCESS= .00	107.68	EXCESS= .00			
117.			PEAK TI FLOW	560	.558.	1155.	1679.	1673.	449.	2035.	SUMMS	PEAK	(CFS	0 558.47	.2898E+02 EXCESS=	0 1675.67				
(AC-FT)	CUMULATIVE AREA =		STATION	80100	R0150	80200	N0200	R0250	80300	N0300		TO	(MIN)	1.00) - INFLOW=	1.00) - INFLOW=	*		
	٠.		OPERATION	HYDROGRAPH AT	ROUTED TO	нуркоскарн ат	2 COMBINED AT	ROUTED TO	HYDROGRAPH AT	2 COMBINED AT		ISTAQ ELEMENT		RO150 MANE	CONTINUITY SUMMARY (AC-FT)	R0250 MANE	CONTINUITY SUMMARY (AC-FT)	*** NORMAL FND OF HEC-1 ***		
		н .	+	+	+	+	+	+	. +	+ -	1				CONTINUIS		CONTINUIS	*** NORMZ		





FREQUENCY ESTIMATES FROM NOAA ATLAS 14 POINT PRECIPITATION

Arizona 32.26 N 110.96 W 2358 feet
from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 3
GM. Bomin, D. Todd, B. Lin, T. Purzybok, M.Yekn, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2003
Extracted: Thi May 25 2006

Precipitation Frequency Estimates (inches)

60 min 0.98

15 min



_	1		1	1.59 2.14 2.65 2.96 3.11 3.27 3.52 4.22 4.87 5.86 6.82 7.44 9.13 10.06 11.15 12.64 1.18 12.04 3.50 3.36 3.57 3.71 3.94 4.80 5.53 6.83 8.04 8.71 10.53 11.38 12.28 13.93 1.96 2.64 3.27 3.77 3.65 3.93 4.08 4.80 5.53 6.05 7.64 9.06 9.77 11.66 12.40 12.11 7.20		
8.23	9.60	10.63	11.64	12.64	13.93	14.88
7.28	8.48	9.38	10.27	11.15	12.28	13.11
6.12	7.26	8.16	9.10	10.06	11.38	12.40
_	_	-		-	-	-
3.09	4.52	5.22	6.00	6.82	8.04	90.6
2.70	3.97	4.55	5.18	5.86	6.83	7.64
70.7	3.01	3.40	3.81	4.22	4.80	5.26
71.7	2.57	2.87	3.19	3.52	3.94	4.28
1.70	2.34	2.63	2.94	3.27	3.71	4.08
						3.27
7.77	1.52	1.72	1.93	2.14	2.43	2.64
3:50	1.13	1.28	1.44	1.59	1.80	1.96
0.1.0	0.91	1.03	1.16	1.28	1.45	1.58

100 200 500

5.84

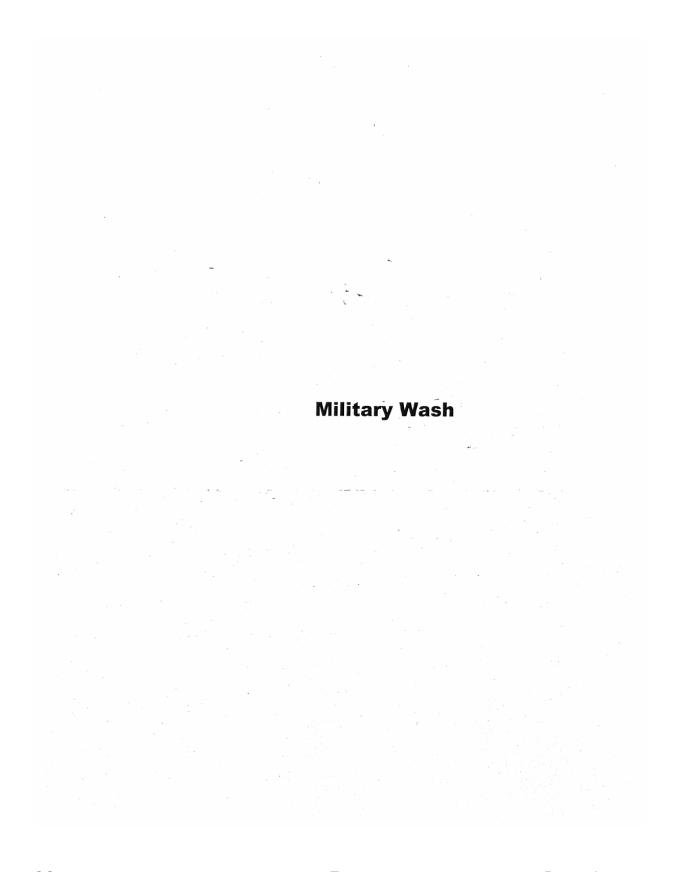
These preciditation frequency estimates are based on a partial duration serties. ANI is the Average Recurrence Inferval.
 Please refer to the <u>documentation</u> for more information. NOTE: Formating forces estimates near zero to appear as zero.

http://hdsc.nws.noaa.gov/cgi-bin/hdsc/buildout.perl?type=pf&series=pd&units=us&statename=ARIZONA&stateabv=az&study... 5/25/2006

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																			1.0f1
	(8	ı				ı					ı								
	Loss (inche				0.13				0.12					0.11					
	(%) Initial	hra														,		es.	
	Impervious				8				52	•				62					
	Adjusted XXSAT Impervious (%) Initial Loss (inches)				0.38				0.38					0.31					
	PSIF Adju				4.4				4.4					4.8					
នី	THETA				0.35				0.35					0.35		•			
Urban Watershed Green Ampt Parameters	XKSAT Composite XKSAT DTHETA											-							
Urban Green Am	Composite				0.35				0.35					0.28	* .		•• .		
	XKSAT	0.687607 0.4	0.312393 0.25	 		87 0.4	0.302433 0.25				0.301299 0.4	0.681385 0.25	0.017316 0.04		-				
	. (se				. -	0.697567				-			0.0173		-				
	Area (acres)	120.4	54.7		175.1	272.4	118.1			390.5	34.8	78.7	8		115.5				
	Texture	gravelly fine sandy loam	loam			lly fine sandy loam	loam				gravelly fine sandy loam	loam	clay loam						
	_	ave grave	Mohave 100%B			ave grave	Mohave 100%B				ave grave	Mohave 100%B	Hantz c						
	Watershed Area (acres) (sq miles) Soi	0.273594 Cave (M 10			0.610156 Cave gravelly fine sandy 100% D loam	Mo 10	. •			0.180469 Cave g	M 10	Ξ Ö						
	Watershed (acres)	175.1				390.5					115.5								
		Watershed D1				Watershed D2					Watershed C								
	'	_																	

			_	
	R 0.25722	0.294741	4921	
	0.2	0.29	0.21	
	s) 8) 8187	0.40432	0.254385 0.214921	
	Tc (hrs) 0.316187	0.40	0.254	
		٠.		
	Impervious (%) 48	52	8	
	mpervic (%) 48	2	62	
	(e) 1	523	382	
(0	ope (f/mile) 128.4482	22.16	21.63	
heter	Slope) (ft/s 327 128	55	88	
ed	Slo (ft/ft) 0.024327	2313	2303	
ershe aph P		0.0	0.0	
Urban Watershed Clark Unit Hydrograph Parameters	Length to Centroid (ft) (miles) 2713 0.513826	0.728598 0.023135 122.1523	0.443939 0.023038 121.6382	
Jrbar t Hyo	Cent (mi 0.51	0.72	0.44	
× Uni	. ∰ . ε 3		2344	
Clar	Leng (ft) 271	3847	234	
		ω,	62	
	gth (miles) 1.245644	1.85928	1.000379	
	Length (m	-	-	
	Le (ft) 6577	9817	5282	
	ea (sq mi) 0.273594	0.610156	0.180469	
	a (sq. 0.273	0.610	0.180	
	<u> </u>			
	A (acres) 175.1	390.5	115.5	
	Basin 100	200	300	
	ш ;			

	Peak ge	
DEC 4 Docules	100-year Peak Discharge (cfs)	503
	Drainage Area (sq mi)	7.06
	LP 3 100- year Peak Discharge (cfs)	845
Urban Watershed 100-year Peak Discharge Comparison 5 Data	LP 3 Period of Record ye	75
Ur 100-year Pe≿ USGS Data		
	Drainage Area (sq mi)	
	Station Name	Cemetery Wash at Tucson, Ariz.



* U.S. ARMY CORPS OF ENGTINEERS	* HYDROLOGIC ENGINEERING CENTER	* 609 SECOND STREET	* DAVIS, CALIFORNIA 95616	* (916) 756-1104	*	XXXXXXX XXXXXX X XX XX XX XX XX XX XX X	PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HECI (JAN 73), HECIGS, HECIDB, AND HECIKW.	THE DEFINITIONS OF VALIABLES -RIMP- AND -RIJOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INDUT STRUCTURE. THE DEFINITION OF -AMSKE- ON RACARD WAS GRANGED WITH REVISIONS BAINED 28 SER BI. THIS IS THE FORTRANT7 VERSION NEW OFTONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS.WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESTRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILITRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALCORITHM	HEC-1 INPUT PAGE 1	4567810	WATERSHED MODEL FOR MILITARY WASH CONSTRUCTED FOR THE ARIZONA [©] STATE STANDARD WORKGROUP HYDROLOGIC MODELING STANDARD	THIS MULTIPLE BASIN MODEL VERSION HAS HAD PARAMETER ADJUSTMENTS BASED ON THE SINCLE BASIN MODEL EVALUATION PERFORMED TO CALIBRATE TO FLOOD FERQUENCY STATISTICS AT THE GAGE. THE FINAL MODEL CONTAINS THE FOLLOWING ADJUSTMENTS FROM THE "DEFAULT" APPROACH:	20 PERCENT IMPERVICUSNESS TO REFLECT ROCK OUTCROP THE URBAN TC EQUATION BASED ON THE PERMISE THAT THE ROCK OUTCROP IS MAKING THE WATERSHED BEHAVE MORE LIKE AN URBANIZED WATERSHED THE DESERFY FANNESLAND TIRE-AREA RELATION IS MAINTAINED IN THIS MODEL. THE DESERFY FANNESLAND TIRE-AREA RELATION IS MAINTAINED IN THIS MODEL. THE IS SOMEWHAT REDUCED IN THIS WODEL TO ADDRESS CONTINUED UNDER PREDICTION OF THE USES FLOOD-FREQUENCY SETTIMATES	300	
* ************************************	* * * * * * * * * * * * * * * * * * *	* VERSION 4.1		* RUN DATE 02JUN06 TIME 14:11:17 *	***************************************	× × × × × × × × × × × × × × × × × × ×	THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF	THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIC THE DEFINITION OF -AMSKE, ON RW-CARD WAS CHANN NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SI DSS:READ TIME SERIES AT DESIRED CALCULATION IN KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITH		LINE ID13456		5 ID THIS MULTIPLE BASIN MODEL EVA 6 ID THE SINGLE BASIN MODEL EVA 7 ID TO FLOOD FREQUENCY STATIST 8 ID THE FOLLOWING ADJUSTMENTS	HE I	ш) (-)	*DIAGRAM

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1. FOR C	Ф С	142	43	7	M BASIN	. প ব	142	
3.6 SQ.MJ 2.52	ot manual	2 110 92 108	MANUAL 20	9	FLOW FRO	MANUAL 20	110 92 108	MANUAL
RAINFALL USING HYPRO-40 REDUCTIONS FOR 8.6 SQ.MI. FOR CENTRAL AZ, 3-HR EXDUCTION PACTOR = 0.83 2.26 8.6 .68 1.28 2.13 2.52 2.71	ASINI COMPUTE RUNOFF FROM BASIN 1 2.82 2.82 0.15 3.55 4.3 0.4 2.0 1.08 0.53 5 8 12 2.0	ROUTE RUNOFF FROM BASIN 1 THROUGH BASIN 2 SLOPE = (637 - 599) / 7603 = 0.005 0.05	COMPUTE RUNOFF FROM BASIN 2 TIME-AREA RELATION IS CURVE C FROM ADOT MANUAL 1.655 0.15 0.15 0.89 0.49 0.3 5 8 12 20		C4L COMBINE KUNOFF FROM BASIN 2 WITH ROUTED FLOW FROM BASIN $_{\rm 2}$	ANSING COMPUTE RUNOFF FROM BASIN 3 COMPUTE RUNOFF FROM BASIN 3 CURVE C FROM ADOT MANUAL 2.539 4.3 0.4 20 1.08 0.66 5 8 12 20 1.00 3 5 8 12 20	R3-4 ROOTE RUNOFF FROM BASIN 3 THROUGH BASIN SLOPE = (605 - 599) / 1870 = 0.003 1 FLOW -1 1870 0.003 0.05 0.035 0.05 1870 0.003 110 109 108 105 105	ASTINA COMPUTE RUNOFF FROM BASIN 4 TIME-ARBA RELATION IS CURVE C FROM ADOT MANUAL 0.15 .35 4.3 0.4 20
0 REDUCT:	SIN 1 S CURVE 0.4	N 1 THROI 7603 = (7600 66	SIN 2 CURVE C	HEC-1 INPUT	SIN 2 WIT	SIN 3 . CURVE C 0.4	N 3 THROU 1870 = 0 1870 66 105	SIN 4 CURVE C
HYDRO-4	FROM BA	ROM BASI - 599) / -1 0.05 60 108	FROM BA	8	FROM BA	COMPUTE RUNOFF FROM BASIN 3 TIME-AREA RELATION IS CURVE. 5.53 35 4.3 0.4 1.08 0.66 5 100 3 5	ROM BASI - 599) / -1 0.05 60 108	FROM BAS ATION IS 4.3
LL USING	E RUNOFE	RUNOFF F (637 ELOW 0.035 109	E RUNOFE AREA REI .35 0.49	2	E RUNOFF	E RUNOFF AREA REL .35 0.66	RUNOFF F = (605 FLOW 0.035 109	E RUNOFF AREA REL
RAINER REDUCT	DASINI COMPUT -TIME 2.82 0.15 1.08 0 100	R1-2 ROUTE SLOPE 4 0.05 0	BASINZ COMPUT TIME- 1.655 0.15 0.89	1	C4L COMBIN	ASIN3 COMPUT TIME- 2.539 0.15 1.08 0	R3-4 ROUTE SLOPE 1 0.05	BASIN4 COMPUT TIME 1.17 0.15
* * GP *	KK KM KM BA LG UC UA	KK KM KM RC RC RX	KK KM KM BA LG UC UA	ID.	KK KM +C	KK KM KM KM CLG UC UC	KK KM KM KX RC RX RX	KK KM BA LG
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43	C4R COMBINE RUNGEF FROM BASIN 4 WITH ROUTED FLOW FROM BASIN 3 2		S	6 7	4.3	м С4									
20	FLOW FRO	+ C4R)	N 5 TO I 110 92	108	MANUAL 20	TLOW FROM			b						
1.2	ROUTED	4 . (C4L	GH BASI) 038 038 86	105 UT 5	OM ADOT 20 12	ROUTED		,	PED FLOW			•			
80	N 4 WITH	COMBINE ALL FLOW FROM BASINS 1 - 4 (C4L + C4R) 2	R4-5 ROUTE COMBINED FLOW FROM C4 THROUGH BASIN 5 TO I-8 SLOPE = (599 - 570) / 7710 = 0.0038 4 FLOW -1 0.05 0.035 0.05 7710 0.0038 110 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	110 109 108 105 105 HEC-1 INPUT	BASINS COMPUTE RUNOFF FROM BASIN 5 1IME—AREA RELATION IS CURVE C FROM ADOT MANUAL 0.422 0.15 .35 4.3 0.4 20 0.39 0.09 3 5 8 12 20 100	CS COMBINE RUNOFF FROM BASIN 5 WITH ROUTED FLOW FROM C4 C-FLOW		(>) DIVERSION OR PUMP FLOW	(<) RETURN OF DIVERTED OR PUMPED FLOW	٠.,					
is.	OM BASI	FROM BA	OW FROM 70) / 7 -1 .05	108	COM BASI	OM BASI) NRC	OR PUM	DIVERT						
0 E	OFF FR	FLOW	NED FL 599 - 5 3W 55 0	90 2	OFF FR RELATI 15 19 3	OFF FR	M NETW	ERSION	URN OF						
0.40	INE RUN	INE ALI	E COMBI PE = (5 FLC 0.03	1	UTE RUNOE E-AREA RE 35 0.09	CS MBINE RUN 2 C-FLOW	F STREA	->) DIV) RET						
100	C4R COMB	C4 COMBJ	R4-5 ROUTJ SLOJ 4 0.05		BASINS COMPU TIME 0.422 0.15 0.39	COMBJ	GRAM OF		<u>-></u>						
WA WA	KK KM HC	KK KM HC	KW K	* * ID	KK I KM KM BA LG UC UA UA	KK KM HC ZW ZZ	IC DIA		W.			BASINZ		BASIN3	V R3-4
							SCHEMATIC DIAGRAM OF STREAM NETWORK	(V) ROUTING	(.) CONNECTOR						
0.2	71 72 73	74 75 76	77 78 79 80 81 82	83 LINE	88 8 8 8 8 9 9 0 0 0 0 0 0 0 0 0 0 0 0 0	922 94 95		(V) RC	00 00	BASIN1	N1-2		C4L		
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					U.S. ARMY CORPS OF ENGINEERS	HYDROLOGIC ENGINEERING CENTER	609 SECOND STREET	DAVIS, CALIFORNIA 95616	(916) 756-1104			ASED ON	ROP ED MODEL.		
						*			•		WATERSHED MODEL FOR MILITARY WASH CONSTRUCTED FOR THE ARTZONA STATE STANDARD WORKGROUP HYDROLOGIC MODELING STANDARD	THIS MULTIPLE BASIN MODEL VERSION HAS HAD PARAMETER ADJUSTMENTS BASED ON THE SINGLE BASIN MODEL FYLLMYTION PERCONENT TO GLAIBRATE TO FLOOD FREQUENCY STATISTICS AG THE GAGE. THE FINAL MODEL CONTAINS THE FOLLOWING ADJUSTMENTS FROM THE "DEFAULT" APPROACH:	THIS PARAMETER SET USES: - 10 PERCENT IMPERIJOSINESS TO REFLECT ROCK OUTCROP - THE URBAN TO EQUATION BASED ON THE PREMISE THAT THE ROCK OUTCROP - THE URBAN TO EQUATION BASED ON THE PREMISE THAT THE ROCK OUTCROP - THE DESERRY/RANGELAND THATARED THE THE MAINTAINED IN THIS MODEL. - THE IS SOMEWHAT REDUCED IN THIS MODEL TO ADDRESS CONTINUED UNDER PREDICTION OF THE USES FLOOD-FREQUENCY ESTIMATES	PRINT CONTROL PLOT CONTROL HYDROGRAPH PLOT SCALE	MINUTES IN COMPUTATION INTERVAL
63 BASIN4 71 C4R	74 C4 V 77 R4-5	84 BASIN5	92 C5	(***) RUNOFF ALSO COMPUTED AT THIS LOCATION 1***********************************	* FLOOD HYDROGRAPH PACKAGE (HEC-1) *	* 1998 *	VERSION 4.1			***************************************	WATERSHED MOD CONSTRUCTED F HYDROLOGIC MO	THIS MULTIPLE BAS THE SINGLE BASIN TO FLOOD FREQUENC THE FOLLOWING ADJ	THIS PARAMETER SE 2 D ERGCRAT IM 1 THE URBAN TO I SAKING THE THE DESERPT RAP THE DESERPT RAP UNDER PREDICT	19 IO OUTPUT CONTROL VARIABLES IPRNT 1 PLOT OPLOT OSCAL 0. HYD	IT HYDROGRAPH TIME DATA NMIN 5 MIN IDATE 5MAY 6 STA

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				.03	1	* * * * * * * * * * * * * * * * * * *							0.96			
				.03									0.06			
				03	. *								75.0			
				.03	****								43.0		.59 HR	
S				.02	***				ANUAL				20.0			PH.
NO 300 NUMBER OF HYDROGRAPH ORDINATES NDTIME 66AY 6 ENDING DATE NDTIME 0055 ENDING TIME ICENT 1.9 CENTURY MARK	COMPUTATION INTERVAL .08 HOURS TOTAL TIME BASE 24.92 HOURS	ENGLISH UNITS DRAINGER REA PRECIPITATION DEPTH INCHES LENGTH, ELEVATION FEET FLOW STORAGE VOLUME STORAGE VOLUME SURFACE AREA SURFACE AREA TEMPERATURE DEGREES FARRENHEIT	INDEX STORM NO. 1 STRM 2.26 PRECIPITATION DEPTH TRDA 8.60 TRANSPOSITION DRAINAGE AREA	PRECIPITATION PATTERN .02 .02 .02 .03 .04 .06 .07 .08 .13 .09 .07 .07 .04 .02 .02 .02 .02	化邻苯 水水井 医水井 医水果 地水布 经水价 经水价 化邻苯 动物病 水水石 化水水 医水水 医水水 医水素 医水子 化水石 医水子		* * **********************************	**************************************	-TIME-AREA RELATION IS CURVE C FROM ADOT MANUAL. SUBBASIN RUNOFF DATA	SUBBASIN CHARACTERISTICS TAREA 2.62 SUBBASIN AREA	GREEN AND AMPT LOSS RATE STRYLL 15 MOLSTURE DEFICIT PEIF 4.30 WETTING FRONT SUCTION XKSAT 7.0.00 PERCENT IMPERATIVE CONDUCTIVITY RTIMP 20.00 PERCENT IMPERATORS AREA	CLARK UNITGRAPH TC 1.08 TIME OF CONCENTRATION R 59 STORAGE COEFFICIENT	ACCUMULATED-AREA VS. TIME, 11 ORDINATES 0 0 100.0	***	UNIT HYDROGRAPH FARAMETERS CLARK TC= 1.08 HR, R= SNYDER TP= .88 HR, CP=	UNIT HYDROGRAPH
			20 JD	21 PI	* * * * *	* * * * * *	22 KK			25 BA	26 LG	27 UC	28 UA			

SS10-07 E-41 December 2007

						*** **									10.22
1780. 620. 151. 37.						* * * * *							1 0 0		8.89
1433. 715. 174. 42.						* * * * *							RIGHT OVERBANK 109.00 110.00 142.00 152.00		7.61
920. 823. 200. 49.						* * *					• • •	N		Æ.	6.38
DINATES 538. 949. 230. 56.	*		1.03	24.92-HR 75. 1.029 155.		**						LEFT OVERBANK N-VALUE MAIN CHANNEL N-VALUE RIGHT OVERBANK N-VALUE ENERGY SLOPE MAX. ELEV. FOR STORRAGE/OUTFLOM CALCULATION	108.	*** COMPUTED STORAGE-OUTFLOW-ELEVATION DATA	5.20
46 END-OF-PERIOD ONDINATES 1259. 324. 538. 1259. 1093. 944. 306. 265. 230. 74. 65. 56.	*					安定者 医骨骨 环状类 计表数 计表数			BASIN 2 5		ITION	E UE SE/OUTFLOW	HANNEL 105. 86.	*** JUTFLOW-EL	67.30
46 END-OF 229. 1259. 306. 74.	*	IN1 O MI	1.23, TOTAL EXCESS	VERAGE	MI	* * * * * *			1 THROUGH 603 = 0.00		NUMBER OF SUBREACHES TYRE OF INITIAL CONDITION INITIAL CONDITION WORKING R AND D COEFFICIENT	LEFT OVERBANK N-VALUE MAIN CHANNEL N-VALUE RIGHT OVERBANK N-VALUE REACH LENOTH ENERGY SLOPE MAX. ELEV. FOR STORAGE	FION DATA MAIN C 00 105.00) STORAGE-	2.97
173. 1450. 352. 86. 21.		TION BASINI 8.6 SQ MI		MAXIMUM 724-HR 78. 1.029 155.	2.82 SQ MI	* * *			ROM BASIN - 599) / 7		NUMBER OF INTYPE OF INTITIAL CO	LEFT OVERBAN MAIN CHANNEL RIGHT OVERBA REACH LENGTH ENERGY SLOPE MAX. ELEV. F	CROSS-SECTION DATA ANK + MA 00 108.00 105 00 60.00 66	COMPUTE	20.89
129. 1621. 406. 99.	*	HYDROGRAPH AT STATION TRANSPOSITION AREA	2.26, TOTAL LOSS =	6-HR 312. 1.029 155.	VE AREA =	* * * * * * * * * * * * * * * * * * * *			ROUTE RUNOFF FROM BASIN 1 THROUGH BASIN 2 SLOPE = (637 - 599) / 7603 = 0.005	3 DATA	4 FLOW -1.00	050	CRO 0.00 109.00 .00 10.00		6.54
88. 1750. 468. 114.	* *	HYDROGR TRANSPOSI	2.26, TO	(CFS) (INCHES) (AC-FT)	CUMULATIVE	* * *	* * *	* * *		HYDROGRAPH ROUTING DATA	STORAGE ROUTING NSTPS ITYP RSVRIC X	NORMAL DEPTH CHANNEL ANL ANCH ANR CHANNEL SEL CHANTH 76 SEL CHANT 111	- 1 #		00.00
33. 1829. 539. 131.			INFALL =	TIME (HR)		* * * * *	******	* * R1-2	***	HYDROGR	STORA	NORMA	ELEVATION		STORAGE OUTFLOW ELEVATION
	* * *		TOTAL RAINFALL	PEAK FLOW + (CFS) + 1611.		***		30 KK			33 RS	34 RC	36 RY 35 RX		0 12

69 65 00																				
52.69 1529.65 110.00																		0.96		
45.83 1307.03 109.74																		0.06		
39.22 1105.70 109.47																		75.0		
32.84 926.24 109.21																		43.0		
26.73 771.61 108.95	* *		24.92-HR	75. 1.029 155.	24.92-HR	1.	24.92-HR	105.45					UAL					20.0		AMETERS
21.51 648.16 108.68	*			75. 1.029 155.	STORAGE 72-HR 24	1.		45					ADOT MAN			Y E.A		12.0	*	GRAPH PAR
17.51 545.46 108.42	* *	-2 MI	MAXIMUM AVERAGE FLOW 24-HR 72-HR		VERAGE STC 72-		MAXIMUM AVERAGE STAGE 24-HR 72-HR	105.45	MI				2 RVE C FROM		EA	SS FICIT NT SUCTION ONDUCTIVIT ERVIOUS AR	CONCENTRATION			UNIT HYDROGRAPH PARAMETERS
14.71 459.22 108.16		10N R1-2 8.6 SQ MI	MAXIMUM 24-HR	78. 1.029 155.	MAXIMUM AVERAGE 24-HR	1.	MAXIMUM 24-HR	105.46	2.82 SQ MI				COMPUTE RUNOFF FROM BASIN 2 TIME-AREA RELATION IS CURVE C FROM ADOT MANUAL		SUBBASIN AREA	STARTING LOSS MOISTURE DEFICIT WEITING FRONT SUCTION HUDBAULIC CONDUCTIVITY PERCENT IMPERVIOUS AREA	TIME OF CONCENTRATI	11 ORDIN		
13.03 387.70 107.89	* *	HYDROGRAPH AT STATION ANSPOSITION AREA	6-HR	311. 1.027 154.	6-HR	ຕໍ	6-HR	106.83	E AREA =				TE RUNOFF -AREA RELA	TA		15 S RATE 3.15 S 35 M 4.30 W 40 H H	.89 T	VS. TIME,		
327.43 107.63	* * *	HYDROGRAPH AT ST TRANSPOSITION AREA		(CFS) (INCHES) (AC-FT)					CUMULATIVE AREA		* *	SIN2 *	COMPU	SUBBASIN RUNOFF DATA	SUBBASIN CHARACTERISTICS TAREA 1.65	AND AMPT STRTL DTH PSIF XKSAT RTIMP	CLARK UNITGRAPH TC R	ACCUMULATED-AREA VS. TIME, 0.0 3.0 100.0		
OUTFLOW ELEVATION			TIME (HB)	2.83		2.83	TIME (HB)	2.83		1	*****	* BASIN2 *		SUBBASII	SUBBA	GREEN	CLARK	ACCUMI 10		
E	* *		PEAK FLOW + (CFS)	+ 1366.	PEAK STORAGE	12.	PEAK STAGE + (FEET)	109.81		***************************************		37 KK			40 BA	41 LG	42 UC	43 UA		

									***										* * *
	1241. 248. 45.								* * * * * * * * * * * * * * * * * * * *										****
	1292. 295. 54.		es						**										**
. 89	1154. 349. 64.							•	* * *		-	4							**
CP=	UNIT HYDROGRAPH 229. 421. 414. 106. 89. 75. 19. 16. 144.	* * *		1.03	24.92-HR	44. 1.029 91.			*** *** *		WITH ROUTED FLOW FROM BESTH 1	BTNE		* * *		24.92-HR	119. 1.029 246.		**
.75 HR,	UNIT HYDROGRAPH D-OF-PERIOD ORD 427. 491. 89.			. 11	FLOW 72-HR	44. 1.029 91.			* * * * * * * * * * * * * * * * * * * *		ROUTED FL	HS TO COM	* *				119. 1.029 246.		***
SNYDER TP=	38 END-C 153. 229. 691. 582. 126. 106. 23. 19.	* * *	N BASIN2 8.6 SQ MI	1.23, TOTAL EXCESS	MAXIMUM AVERAGE FLOW 24-HR 72-HR	46. 1.029 91.	1.65 SQ MI		* *** *** ***		OM BASIN 2 WITH	NUMBER OF HYDROGRAPHS TO COMBINE		* *	N C4L 8.6 SQ MI	MAXIMUM AVERAGE FLOW 24-HR 72-HR	124. 1.029 1 246.	4.47 SQ MI	* *** ** ** **
	107. 819. 149. 27.	* *	HYDROGRAPH AT STATION TRANSPOSITION AREA	AL LOSS =	6-HR	183. 1.029 91.			* *		COMBINE RUNOFF FROM BASIN 2	01		* *	HYDROGRAPH AT STATION TRANSPOSITION AREA	6-HR	494. 1.026 245.	AREA =	
	71. 971. 177.	* *	HYDROGRA	2.26, TOTAL LOSS		(CFS) (INCHES) (AC-FT)	CUMULATIVE AREA =		黄芩类 水黄素 黄黄素 法有效	* * *		HYDROGRAPH COMBINATION ICOMP		* *	HYDROGRA		(INCHES) (AC-FT)	CUMULATIVE	***************************************
	28. 1122. 209.			INFALL =	TIME (HR)	2.25			***	**************************************	*	HYDROC		*		TIME (HR)	2.75		**
		* * *		TOTAL RAINFALL	PEAK FLOW + (CFS)	+ 1102.			* *** * ***	45 KK	r 7	47 HC		* * *		PEAK FLOW + (CFS)	+ 1878.		***************************************

								***										* * * * *
	1241. 248. 45.							* * * * * * * * * * * * * * * * * * * *										* **
	1292. 295. 54.		e					* * * *										* * * *
.89	1154. 349. 64.							* * * * * * * * * * * * * * * * * * * *		- z								** ** ** ** **
CP=	APH ORDINATES 795. 414. 75.	* *		1.03	24.92-HR	44. 1.029		**		WITH ROUTED FLOW FROM BASIN 1	SINE		*		24.92-HR	119. 1.029 246.		**
.75 HR,	UNIT HYDROGRAPH 229. 427. 795. 582. 491. 414. 106. 89. 15.			11		44. 1.029 91.		* * * * *		ROUTED FLO	NUMBER OF HYDROGRAPHS TO COMBINE	* *				119. 1.029 246.		* * * *
TP=	38 END-OI 229. 582. 106.	* *	IN2	1.23, TOTAL EXCESS	MAXIMUM AVERAGE FLOW 24-HR 72-HR		MI	* * * * * * * * * * * * * * * * * * * *		2	0		* * *	MI	VERAGE		MI	* * * * * * * * * * * * * * * * * * * *
SNYDER	153. 691. 126. 23.		ION BASIN2 8.6 SQ MI	1.23, 1	MAXIMUM 24-HF	46. 1.029 91.	1.65 SQ MI	***		ROM BASIN	MBER OF H			8.6	MAXIMUM P 24-HR	124. 1.029 246.	4.47 SQ MI	* * * * * * * * * * * * * * * * * * * *
	107. 819. 149. 27.	* *	HYDROGRAPH AT STATION TRANSPOSITION AREA	TAL LOSS =	6-HR	183. 1.029 91.	CUMULATIVE AREA =	* *		COMBINE RUNOFF FROM BASIN	01		*** HYDROGRADH AT CTATOM	TION AREA	6-HR	494. 1.026 245.	TE AREA =	***
	71. 971. 177.	* *	HYDROGR	2.26, TOTAL LOSS		(CFS) (INCHES) (AC-FT)	CUMULATI	*** *** *** ***	* * * *	*****	HYDROGRAPH COMBINATION ICOMP		*** HYDROGRA	TRANSPOSITION AREA		(CFS) (INCHES) (AC-FT)	CUMULATIVE AREA =	* * * * * *
	28. 1122. 209. 38.			INFALL =	TIME (HR)	2.25		***	**************************************	*****	HYDROG				TIME (HR)	2.75		* * * *
		**		TOTAL RAINFALL =	PEAK FLOW + (CFS)	+ 1102.		**	45 KK *		47 HC		K K		PEAK FLOW + (CFS)	+ 1878.		* *** * * * * * * * * * * * * * * * * *

							2.52 210.68 107.37	12.96 1184.86 110.00								
				1000			2.19 171.46 107.11	11.28 1012.42 109.74	ABLE	ABLE	BLE					
				RBANK 110 152			1.87 135.96 106.84	9.65 856.47 109.47	UTFLOW TZ	UTFLOW TZ	UTFLOW TZ					
						4	1.57 104.21 106.58	8.08 717.46 109.21	STORAGE-C	STORAGE-C	IN STORAGE-OUTFLOW TABLE					
			ALCULATIO	108.		ATION DAT	1.28 76.24 106.32	6.58 597.69 108.95	1185.) IN STORAGE-OUTFLOW TABLE	1185.) IN STORAGE-OUTFLOW TABLE	1185.) IN		24.92HR	68. 1.029 139.	2-HR	2-HR
A 4		, E	JTFLOW C	105.00 86.00		COW-ELEV	1.00 52.13 106.05	5.29 502.07 108.68) MOT	_) WO"		24.9		24.	24.92-HR
ROUTE RUNCFF FROM BASIN 3 THROUGH BASIN 4 SLOPE = (665 - 599) / 1870 = 0.003		NUMBER OF SUBREACHES TYPE OF INITIAL CONDITION INITIAL CONDITION WORKING R AND D COEFFICIENT	LEFT OVERBANK N-VALUE MAIN CHANNEL N-VALUE RIGHT OVERBANK N-VALUE EXHECH INNETH EXHECT INNETH EXHERGY SLOPE MAX. ELEV. FOR STORAGE/OUTFLOM CALCULATION	TION DATA MAIN CHANNEL 105.00 105.00 00 66.00 86.00	* *	5	32.03 52 105.79 106	4.31 502 422.51 502 108.42 108	1243.) IS GREATER THAN MAXIMUM OUTFLOW	1273.) IS GREATER THAN MAXIMUM OUTFLOW	1243.) IS GREATER THAN MAXIMUM OUTFLOW ***	R3-4 SQ MI	MAXIMUM AVERAGE FLOW 24-HR 72-HR	, 68. 1.029	MAXIMUM AVERAGE STORAGE 24-HR 72-HR 1. 1.	MAXIMUM AVERAGE STAGE 24-HR 72-HR
KOM BASIN - 599) / 1		NUMBER OF TYPE OF IN INITIAL CO	LEFT OVERBAN MAIN CHANNEL RIGHT OVERBA REACH LENGTH ENERGY SLOPE MAX. ELEV. F	CROSS-SECTION DATA NNK + MA 108.00 105		COMPUTE	16.18	3.62 355.71 108.16	EATER THAI	EATER THAI	EATER THAN	8.6	MAXIMUM 24-HR	70. 1.029 139.	MAXIMUM AV 24-HR 1.	MAXIMUM 24-HR
RUNOFF FI	DATA	FLOW 7	050 035 050 70.	CRC 110.00 109.00 .00 10.00		000	5.07	3.20 300.31 107.89	43.) IS GR	73.) IS GR	43.) IS GR	HYDROGRAPH AT STATION ANSPOSITION AREA	6-HR	281. 1.028 139.	6-HR	6-HR
* * * *	HYDROGRAPH ROUTING DATA	STORAGE ROUTING NSTPS ITYP RSVRIC X	NORWAL DEPTH CHANNEL AND AND ANR ANR RELWTH 18 SEL 0 ELMAX 111			00	105.00	2.85 253.63 107.63		_	_	HYDROGRAPH AT ST TRANSPOSITION AREA		(INCHES)		
* * * * * * * * * * * * * * * * * * *	HYDROGRA	STORAGI 1	NORMAL	ELEVATION		STORAGE		STORAGE OUTFLOW ELEVATION	- ROUTED OUTFLOW	- ROUTED OUTFLOW	- ROUTED OUTFLOW ***	T	TIME (HR)	2.58	3E TIME (HR) 2.58	TIME
56 KK		59 RS	60 RC	62 RY 61 RX				ľ	WARNING	1.	WARNING		PEAK FLOW + (CFS)	+ 1273.	PEAK STORAGE + (AC-FT) 14.	PEAK STAGE

	* * * * * * * * * * * * * * * * * * * *									•					
	* * * * *						96.0								
	** ** **						0.06		885. 111. 14.						
	* * * * * * * * * * * * * * * * * * * *						75.0		1020. 137. 17.						
	* * * * * * * * * * * * * * * * * * *						43.0	.40 HR	1086. 169. 21.						
105.48	k k	IUAL					20.0		H DINATES 947. 209. 26.	*		1.03	24.92-HR	31. 1.029 64.	
105.48		M ADOT MAN			N TY REA	z		UNIT HYDROGRAPH PARAMETERS TC= .78 HR, R= TP= .66 HR, CP=	UNIT HYDROGRAPH 292 - PERIOD OKDINATES 317 257 209 39 32 26	*				31. 1.029 64.	
. ,		4 RVE C FRO		EA	SS FICIT VT SUCTION ONDUCTIVI	SENTRATIO FFICIENT		NIT HYDR TC= TP=	UNIT 292. 317.	* *	MI	1.23, TOTAL EXCESS	VERAGE F	Ä	I
2.54 SG		FROM BASIN		SUBBASIN AREA	STARTING LOSS MOISTURE DEFICIT WETTING FRONT SUCTION HYDRAULIC CONDUCTIVITY PERCENT IMPERVIOUS AREA	TIME OF CONCENTRATION STORAGE COEFFICIENT	11 ORDINATES 5.0 8.0	CLARK	159. 391. 48.		ON BASIN4 8.6 SQ MI	1.23, TC	MAXIMUM AVERAGE FLOW 24-HR 72-HR	32. 1.029 64.	1.17 SQ MI
ο u *		COMPUTE RUNOFF FROM BASIN 4 TIME-AREA RELATION IS CURVE C FROM ADOT MANUAL	ľA			.78 TI	VS. TIME,		104. 481. 59.	* *	HYDROGRAPH AT STATION TRANSPOSITION AREA	Tross =	6-нк	130. 1.029 64.	AREA =
106.9 CUMULATIVE AREA *** *** *** ***	* * * *		SUBBASIN RUNOFF DATA	SUBBASIN CHARACTERISTICS TAREA 1.17	GREEN AND AMPT LOSS RATE STRTL 15 DTH 35 PIT 4.30 KKSAT 4.00 RTIMP 20.00	CLARK UNITGRAPH TC R	ACCUMULATED-AREA VS. TIME, 0.0 0.0 3.0 100.0		68. 593. 73. 9.	* *	HYDROGRAF TRANSPOSITI	2.26, TOTAL LOSS		(CFS) (INCHES) (AC-FT)	CUMULATIVE AREA =
*** *** *** *** *** ***	* * BASIN4 * *	*****	SUBBASIN	SUBBAS	GREEN	CLARK 1	ACCUMUJ 100		27. 731. 90.	*		FALL =	TIME (HR)		
**************************************	M	• #		66 BA	67 LG	68 .UC	69 UA			* *		TOTAL RAINFALL	PEAK FLOW (CES)	904.	
* *	** ** ** **			99	67	89	69						PEAI	+	

**** *** *** *** *** ***						水水水 水水水 女亲女 女亲女 化水水							
* * * *						***							
***						* * * *							
*** ***		COMBINATION COMBINATION 2 NUMBER OF HYDROGRAPHS TO COMBINE *** *** ***	24.92-HR	99. 1.029 204.		***		(C4L + C4R)	OMBINE		* * *	24.92-HR	218. 1.029 449.
***		TH ROUTED	SE FLOW 72-HR	.99. 1.029 204.		* *	**	4 (C4)	APHS TO	* *		E FLOW 72-HR	218. 1.029 449.
***		F FROM BASIN 4 WITH ROUTED FLOW FINDMER OF HYDROGRAPHS TO COMBINE *** ***	FION C4R 8.6 SQ MI MAXIMUM AVERAGE FLOW 24-HR 72-HR	103. 1.029 204.	3.71 SQ MI	***		COMBINE ALL FLOW FROM BASINS 1	2 NUMBER OF HYDROGRAPHS TO COMBINE		*** TON C4 8.6 SQ MI	MAXIMUM AVERAGE FLOW 24-HR 72-HR	226. 1.029 449.
* * * *		IE RUNOFF	H AT STA ON AREA 6-HR	410. 1.028 203.	AREA =	**		E ALL FLO	ATION 2 N		*** H AT STAT ON AREA	6-HR	904. 1.027 448.
***	* * * * * * * * * * * * * * * * * * *	H W	HYDROGRAPH AT STATION TRANSPOSITION AREA M	(CFS) (INCHES) (AC-FT)	CUMULATIVE AREA =	***	* * C * * * * * * * * * * * * * * * * *	COMBIN	HYDROGRAPH COMBINATION ICOMP	· · · · · · · · · · · · · · · · · · ·	*** HYDROGRAPH AT STATION TRANSPOSITION AREA		(CFS) 904. (INCHES) 1.027 (AC-FT) 448.
	* * * * * * * * * * * * * * * * * * *	нур	TIME (HR)	2.50		* * * *	* * * * * * * * * * * * * * * * * * * *		HYDE			TIME (HR)	2.58
***	71 KK	73 HC ***	PEAK FLOW + (CFS)	+ 1806.		***	74 KK		76 HC	**		PEAK FLOW + (CFS)	+ 3484.

*** ** ** ** ** ** ** ** ** ** ** ** **								109.00 110.00 109.00 110.00 142.00 152.00		7.72 9.02 10.37 153.02 192.97 237.11 106.84 107.11 107.37	39.78 46.50 53.45 963.92 1139.44 1333.52 109.47 109.74 110.00	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFIOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE	STORAGE-OUTFLOW TABLE
*** *** *** *** *** ***				TO I-8) CALCULATION	108.00	EVATION DATA	5.27 6.47 85.80 117.28 106.32 106.58	27.12 33.32 672.68 807.48 108.95 109.21	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE	1334.) IN STORAGE
***				C4 THROUGH BASIN 5 10 = 0.0038		NUMBER OF SUBREACHES TYPE OF INITIAL CONDITION INITIAL CONDITION WORKING R AND D COEFFICIENT	IEFT OVERBANK N-VALUE MAIN CHANNEL N-VALUE RIGHT OVERBANK N-VALUE ENERCH LENGTH ENERGY SLOPE MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION	LON DATA MAIN CHANNEL 105.00 105.00 0 66.00 86.00	STORAGE-OUTFLOW-ELEVATION DATA	3.02 4.12 36.05 58.67 105.79 106.05	17.76 21.82 475.52 565.06 108.42 108.68	GREATER THAN MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (THAN MAXIMUM OUTFLOW.	THAN MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (
* * * * * * * * * * * * * * * * * * * *				ROUTE COMBINED FLOW FROM C4 THROUGH BASIN SLOPE = (599 - 570) / 7710 = 0.0038	ľA	4 NUMBER OF SI FLOW TYPE OF INIT -1.00 INITIAL CON .00 WORKING R AN	050 035 050 10.	CROSS-SECTION DATA OVERBANK + MA 109.00 108.00 105 10.00 60.00 66	COMPUTED	.96 1.96 5.70 18.21 105.26 105.53	13.21 14.92 337.99 400.34 107.89 108.16	IS	IS GREATER THAN	IS GREATER	IS GREATER	IS GREATER	IS GREATER	IS GREATER	IS GREATER THAN	3434.) IS GREATER THAN MAXIMUM OUTFLOW
**				ROUTE CON SLOPE =	ROUTING DAT		CHANN	110.00		.00 .00 105.00 105	11.77 13 285.45 337 107.63 107	(1452.)	(2014.)	(2518.)	(2905.)	(3171.)	(3330.)	(3413.)	(3447.)	_
**************************************	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	* R4-5 *	* ******		HYDROGRAPH ROUTING DATA	STORAGE ROUTING NSPPS ITYP RSVRIC X	NORMAL DEPTH ANL ANCANCH ANR RLWTH SEL	ELEVATION DISTANCE		STORAGE OUTFLOW ELEVATION 10	STORAGE 1 OUTFLOW 28 ELEVATION 10	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW
* * * * * *		77 KK				80 RS	81 RC	83 RY 82 RX				WARNING	WARNING -	WARNING -	WARNING -	WARNING -	WARNING -	WARNING -	WARNING -	WARNING -

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	IN STORAGE-OUTFLOW TABLE	N STORAGE-OUTFLOW TABLE	IN STORAGE-OUTFLOW TABLE	N STORAGE-OUTFLOW TABLE	V STORAGE-OUTFLOW TABLE	STORAGE-OUTFIOW TABLE	- STATES STATES	STORAGE-COIFLOW TABLE																								
	1334.) I	1334.) II	1334.) II	1334.) IN	1334.) II	1334.) IN	1334.) IN	1334.) IN																								
	MAXIMUM OUTFLOW (THAN MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (THAN MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (MAXIMUM OUTFLOW (XIMUM OUTFLOW (
GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN MA	GREATER THAN MA	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN M	GREATER THAN MA	GREATER THAN M	GREATER THAN ME	GREATER THAN M	GREATER THAN MA	GREATER THAN MA	GREATER THAN MA	GREATER THAN MA	GREATER THAN MAXIMUM	
ES E	S	(3044.) IS	(2829.) IS	(2600.) IS	(2372.) IS	(2154.) IS	(1951.) IS ((1763.) IS ((1589.) IS ((1423.) IS ((1349.) IS ((1858.) IS ((2332.) IS ((2724.) IS ((3016.) IS	(3213.) IS ((3334.) IS (3393.) IS (3396.) IS (3340.) IS	3227.) IS (3066.) IS	2871.) IS C	2657.) IS G	2438.) IS G	2224.) IS G	2020.) IS G	1829.) IS G	1650.) IS G	1478.) IS G	1718.) IS G	
ROUTED OUTFLOW		ROUTED OUTFLOW	ROUTED OUTFLOW	ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (ROUTED OUTFLOW (
WARNING ROI	1	WARNING ROI	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROL	WARNING ROI	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROL	WARNING ROL	WARNING ROU	WARNING ROL	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU	WARNING ROU								

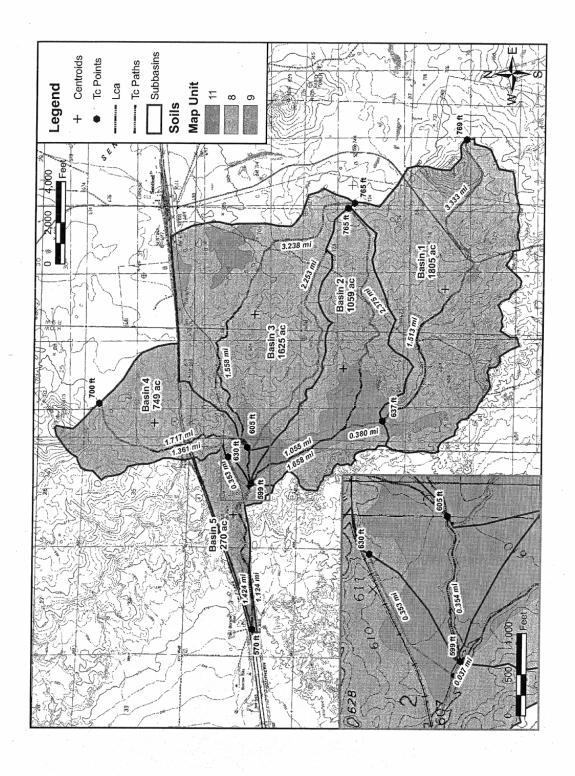
WARNING -	ROUTED		<u>. </u>	2867.)	ES	GREATER	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	3093.)	S	GREATER	THAN	THAN MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	3243.)	IS	GREATER	THAN	THAN MAXIMUM	OUT	OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	3327.)	ES.	GREATER	THAN	THAN MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	\smile	3350.)	IS	GREATER	THAN	THAN MAXIMUM OUTFLOW	OUT	FLOW (1334:)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	\smile	3313.)	IS	GREATER	THAN	MAXIMUM		OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	_ '	3220.)	IS	GREATER	THAN	MAXIMUM	OUT	OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	3080.)	IS	GREATER	THAN	THAN MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW		2905.)	IS	GREATER	THAN	MAXIMUM	OUT	OUTFLOW (1334.)	IN	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_ '	2706.)	IS	GREATER	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	IN	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	_	2498.)	IS	GREATER	THAN	MAXIMUM		OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	2289.)	IS	GREATER	THAN	MAXIMUM		OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	\smile	2087.)	IS	GREATER	THAN	MAXIMUM		OUTFLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	· .	1894.)	IS	GREATER THAN	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	· 	1711.)	IS	GREATER THAN	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	IN	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	\smile	1536.)	S.	GREATER THAN	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW 1	TABLE
WARNING -	ROUTED	OUTFLOW	_	1366.)	IS	GREATER THAN	THAN	MAXIMUM OUTFLOW	OUT	FLOW (1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	_	1591.)	SI	GREATER	THAN	MAXIMUM		OUTFLOW (1334.)	IN	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	_	2019.)	IS	GREATER	THAN	MAXIMUM OUTFLOW	OUTI	TOM (1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	\smile	2404.)	IS	GREATER	THAN	MAXIMUM	OUTFLOW) MOTA	1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	_	2724.)	SH	GREATER	THAN	MAXIMUM	OUTFLOW) MOTE	1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	_ '	2970.)	HS	GREATER	THAN	MAXIMUM OUTFLOW	OUTE) MOTE	1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	ROUTED OUTFLOW	_	3145.)	IS	GREATER	THAN	MAXIMUM	OUTFLOW	LOW (1334.)	N	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	_	3252.)	IS	GREATER	THAN	MAXIMUM	OUTFLOW	TOM (1334.)	NI	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	_	3296.)	IS	GREATER 1	THAN	MAXIMUM	OUTFLOW	TOM (1334.)	IN	STORAGE-OUTFLOW T	TABLE
WARNING -	ROUTED	OUTFLOW	٠	3280.)	IS	GREATER	THAN	MAXIMUM OUTFLOW	OUTE	LOW (1334.)	INS	STORAGE-OUTFLOW T	TABLE
WARNING -	ROUTED	OUTFLOW	_	3208.)	IS	GREATER 1	THAN	MAXIMUM OUTFLOW	OUTE	·) MOT	1334.)	INS	STORAGE-OUTFLOW T	TABLE
WARNING -	ROUTED	OUTFLOW		3088.)	IS	GREATER THAN MAXIMUM OUTFLOW	THAN	MÄXIMUM	OUTE	TOM (1334.)	INS	STORAGE-OUTFLOW T	TABLE
WARNING -	ROUTED	OUTFLOW	_	2931.)	IS	GREATER 1	THAN	MAXIMUM	OUTFLOW) MOT	1334.)	IN	STORAGE-OUTFLOW I	TABLE
WARNING -	ROUTED	OUTFLOW	_	2749.)	IS	GREATER 1	THAN	MAXIMUM	OUTFLOW	LOW (1334.)	IN	STORAGE-OUTFLOW T	TABLE
WARNING -	ROUTED	OUTFLOW	_	2551.)	IS	GREATER T	THAN	MAXIMUM OUTFLOW	OUTE) MOTA	1334.)	INS	STORAGE-OUTFLOW T	TABLE
WARNING	ROUTED	OUTFLOW	٠	2350.)	SI	GREATER 1	THAN	MAXIMUM OUTFLOW	OUTE	LOW (1334.)	NI	STORAGE-OUTFLOW T	TABLE
WARNING	ROUTED	OUTFLOW		2150.)	SI	GREATER 7	THAN	MAXIMUM	OUTFLOW	TOW (1334.)	NI	STORAGE-OUTFLOW T	TABLE
WARNING	ROUTED	OUTFLOW	_	1957.) IS		GREATER I	THAN	MAXIMUM	OUTFLOW	LOW (1334.)	INS	STORAGE-OUTFLOW I	TABLE

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### ##################################	(1334.) IN STORAGE-OUTFLOW TABLE ***	24.92-нк	218. 1,029 449.	24.92-нг 2.	24.92-нR 105.83		水果水 精彩水 食水布 化焊件 空水水 化水环 化水环 医喉管 医水素 化水管 化苯胺 化水平 化水平 化水平	NUAL		20.0 43.0 75.0 90.0 96.0
	(1423.) IS GREATER THAN MAXIMUM OUTELOW *** *** CDROGRAPH AT STATION R4-5	TRANSPOSITION AREA 8.6 SQ MI MAXIMUM AVERAGE FLOW 6-HR 24-HR 72-HR	(CFS) 902. 226. (INCHES) 1.025 1.029 (AC-FT) 447. 449.	MAXIMUM AVERAGE STORAGE 6-HR 72-HR 9. 2. 2.	MAXIMUM AVERAGE STAGE 24-HR 72-HR 108.30 105.86 105.83	1	* * * * * * * * * * * * * * * * * * * *	3ASIN5 * *******	SUBBASIN RUNOFF DATA SUBBASIN CHARACTERISTICS TARRA 142 SUBBASIN AREA	IME OF CONCENTRATIC FORAGE COEFFICIENT 11 ORDINATES 5.0 8.0

				* * * * * * * * * * * * * * * * * * * *							TIME OF MAX STAGE
				* * * * * * * * * * * * * * * * * * * *							MAXIMUM STAGE
				* * * * * * * * * * * * * * * * * * * *							BASIN
CLARK SNYDER 167. 586. 1033.	*** *** *** *** *** *** *** ***	MAXIMUM AVERAGE FLOW 24-HR 72-HR 1.031 23. 23.	CUMULATIVE 2	在香港 香港市 香港市 香港市 香港市 香港市 香港市 香港市 香港市 香港市 香	** ** **	94 HC HYDROGRAPH COMBINATION 2 NUMBER OF HYDROGRAPHS TO COMBINE 1COMP A***	*** *** *** *** *** HYDROGRAPH AT STATION C5 TRANSPOSITION AREA 8.6 SQ MI	FEAK FLOW TIME 6-HR 24-HR 72-HR 24.92-HR + (CFS) (HR) (CFS) 947. 238. 229. 1.029 1.029	470. 472. 472. IVE AREA = 8.61 SQ MI	RUNOFF SUMMARY FLOW IN CUBIC FEET PER SECOND TIME IN HOURS, AREA IN SQUARE MILES	PEAK TIME OF AVERAGE FLOW FOR MAXIMUM PERIOD + 6-HOUR 24-HOUR 72-HOUR

	000	00.7			8 11				900					
	200	, , , ,			110.13				112.66					
2.82	2.82	1.65	4.47	2.54	2.54	1.17	3.71	8.18	8.18	.42	8.61			
75.	75.	44.	119.	. 69	. 68	31.	.66	218.	218.	11.	229.			
78.	78.	46.	124.	70.	70.	32.	103.	226.	226.	12.	238.		سريد	
312.	311.	183.	494	281.	281.	130.	410.	904.	902.	47.	947.			
2.42	2.83	2.25	2.75	2.42	2.58	2.17	2.50	2.58	3.00	1.83	3.00			
1611.	1366.	1102.	1878.	1356.	1273.	904.	1806.	3484.	3296.	727.	3306.			
BASIN1	R1-2	BASINZ	C4L	BASIN3	R3-4	BASIN4	C4R	C4	R4-5	BASINS	CS CS	* *		
HYDROGRAPH AT	ROUTED TO	нуркоскарн ат	2 COMBINED AT	HYDROGRAPH AT	ROUTED TO	HYDROGRAPH AT	2 COMBINED AT	2 COMBINED AT	ROUTED TO	нуркоскарн ат	2 COMBINED AT	*** NORMAL END OF HEC-1 ***		
+	+ +	+	+	* ,	++,	+	+	+	++	+ 4	+	**		





POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

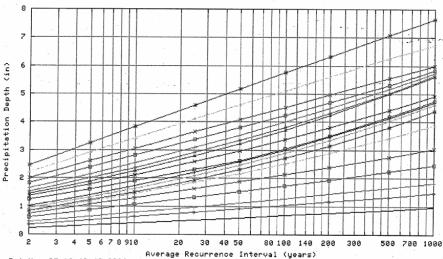


Arizona 32.84 N 113.23 W 702 feet
from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 3
G.M. Bonnin, D. Todd, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2003
Extracted: Fri May 5 2006

600000000000000000000000000000000000000	ec State of							SSOCIETY NAME OF THE OWNER.	erne armanen	cted: Fri	HAR DEBUGGER STORY	PROGRAMMENT CONTRACTOR CO.	anne meaned	Carrow and the Carrow	-	ment recommon	manuscrate of	THE REAL PROPERTY AND ADDRESS.		end communications	
Co	nfiden	ce Lir	nits	3	Seaso	nality		Locat	ion Ma	aps	0	ther In	ifo.	GIS	data	Ma	aps	Help	Docs	U.S	S. Mar
]	Preci	pitati	on F	reque	ncy I	Estim	ates	(inch	es)								
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	11	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day			
2	0.24	0.36	0.45	0.60	0.74	0.82	0.85	0.94	1.01	1.24	1.36	1.44	1.54	1.64	1.83	2.01	2.22	2.46			
5	0.34	0.51	0.64	0.86	1.06	1.17	1.21	1.32	1.41	1.61	1.77	1.89	2.00	2.14	2.39	2.61	2.92	3.25			
10	0.41	0.63	0.78	1.05	1.30	1.45	1.50	1.63	1.73	1.90	2.10	2.25	2.37	2.53	2.81	3.05	3.44	3.84			
25	0.52	0.79	0.97	1.31	1.62	1.85	1.94	2.08	2.20	2.30	2.58	2.79	2.91	3.09	3.37	3.65	4.10	4.60	-		
50	0.60	0.91	1.12	1.51	1.87	2.17	2.30	2.46	2.59	2.62	2.97	3.23	3.35	3.54	3.81	4.09	4.61	5.18			
100	0.68	1.03	1.28	1.72	2.13	2.52	2.71	2.88	3.01	3.04	3.37	3.71	3.82	4.01	4.25	4.53	5.11	5.75			
200	0.76	1.16	1.44	1.94	2.40	2.90	3.16	3.35	3.47	3.50	3.81	4.24	4.32	4.50	4.70	4.97	5.61	6.33			
500	0.88	1.33	1.65	2.22	2.75	3.43	3.82	4.04	4.14	4.18	4.43	4.99	5.03	5.19	5.30	5.55	6.26	7.08			
1000	0.97	1.47	1.83	2.46	3.04	3.88	4.39	4.63	4.71	4.75	4.92	5.62	5.66	5.74	5.85	5.99	6.74	7.64			
L'orania de la companya della companya della companya de la companya de la companya della compan																					

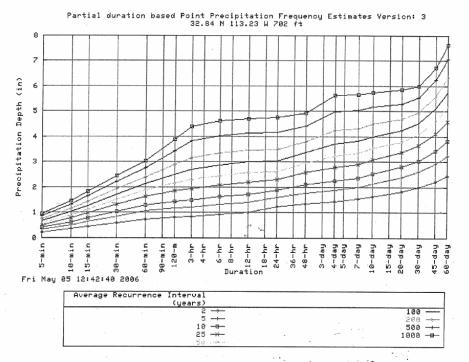
Text version of table 'These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more Information. NOTE: Formatting forces estimates near zero to appear as zero.

Partial duration based Point Precipitation Frequency Estimates Version: 3 32.84 N 113.23 W 702 ft



Fri	Mau	05	12:42:40	2006

	Duration				 		 	
	5-min		120 -a	man of the same	48-hr	>(30-day -*-
	.10-min		3-hr		4-day			45-day
	15-min	, 	6-130		7-dau			60-day -*-
-	30-min	-5-	12-hr		· 10-day			
- 1	60-min	-	24-hr	-6-	20-420			



Confidence Limits -

	,											e inte (inch						
ARI** (years)		10 min	15 min	30 min	60 min	120 min	3 hr	6 hr		24 hr		4 day	7 day	10 day	20 day	30 day		60 day
												1.72						
5	0.40	0.61	0.75	1.01	1.25	1.40	1.44	1.53	1.60	1.88	2.06	2.27	2.38	2.54	2.83	3.10	3.46	3.86
10	0.49	0.74	0.92	1.24	1.54	1.73	1.78	1.89	1.97	2.22	2.43	2.72	2.84	3.02	3.32	3.62	4.05	4.54
25	0.61	0.93	1.15	1.55	1.91	2.20	2.29	2.41	2.50	2.68	3.00	3.38	3.47	3.70	3.99	4.35	4.87	5.46
50	0.70	1.07	1.33	1.79	2.21	2.59	2.73	2.87	2.97	3.05	3.47	3.94	4.02	4.27	4.54	4.88	5.49	6.19
100	0.81	1.23	1.52	2.05	2.54	3.03	3.24	3.38	3.48	3.51	3.97	4.55	4.61	4.92	5.14	5.49	6.14	6.93
200	0.91	1.39	1.72	2.32	2.87	3.50	3.80	3.96	4.06	4.11	4.56	5.27	5.27	5.63	5.71	6.09	6.78	7.69
500	1.06	1.62	2.00	2.70	3.34	4.21	4.65	4.86	4.94	4.99	5.37	6.33	6.39	6.61	6.69	6.89	7.75	8.80
1000	1.19	1.80	2.24	3.01	3.73	4.84	5.43	5.67	5.74	5.79	6.12	7.24	7.31	7.50	7.58	7.77	8.46	9.62

^{*}The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.

** These precipitation frequency estimates are based on a partial duration series, ARI is the Average Recurrence interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

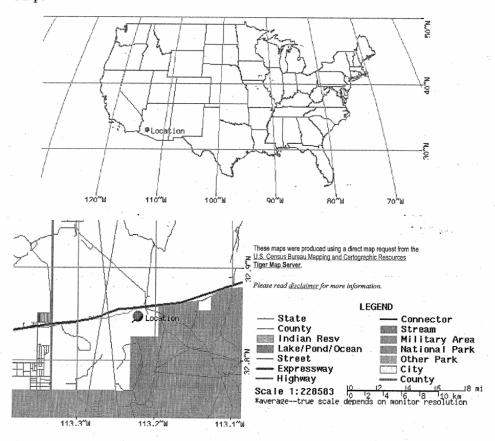
			-		Lowe Precij										-			
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	0.20	0.30	0.38	0.51	0.62	0.68	0.73	0.82	0.89	1.05	1.16	1.19	1.28	1.36	1.50	1.64	1.82	2.00
5	0.28	0.43	0.54	0.72	0.89	0.98	1.03	1.14	1.23	1.37	1.52	1.56	1.67	1.75	1.97	2.13	2.40	2.65
10 .	0.35	0.53	0.66	0.88	1.09	1.20	1.27	1.39	1.50	1.61	1.79	1.84	1.96	2.06	2.31	2.48	2.82	3.14

0.43	0.65	0.81	1.09	1.34	1.52	1.60	1.75	1.88	1.94	2.17	2.26	2.38	2.50	2.76	2.95	3.35	3.73
0.49	0.75	0.93	1.25	1.54	1.76	1.87	2.03	2.17	2.21	2.47	2.60	2.71	2.83	3.09	3.28	3.76	4.18
0.55	0.84	1.04	1.40	1.74	2.00	2.15	2.33	2.47	2.49	2.76	2.94	3.06	3.16	3.42	3.61	4.12	4.61
0.61	0.93	1.16	1.56	1.93	2.25	2.45	2.63	2.77	2.80	3.08	3.28	3.39	3.48	3.71	3.91	4.47	5.00
0.69	1.04	1.29	1.74	2.16	2.59	2.86	3.05	3.19	3.23	3.47	3.72	3.83	3.90	4.08	4.27	4.90	5.49
0.74	1.13	1.40	1.89	2.33	2.85	3.17	3.38	3.53	3.56	3.77	4.07	4.20	4.24	4.40	4.52	5.17	5.81
).49).55).61).69	0.49 0.75 0.55 0.84 0.61 0.93 0.69 1.04	0.49 0.75 0.93 0.55 0.84 1.04 0.61 0.93 1.16 0.69 1.04 1.29	0.49 0.75 0.93 1.25 0.55 0.84 1.04 1.40 0.61 0.93 1.16 1.56 0.69 1.04 1.29 1.74	0.49 0.75 0.93 1.25 1.54 0.55 0.84 1.04 1.40 1.74 0.61 0.93 1.16 1.56 1.93 0.69 1.04 1.29 1.74 2.16	0.49 0.75 0.93 1.25 1.54 1.76 0.55 0.84 1.04 1.40 1.74 2.00 0.61 0.93 1.16 1.56 1.93 2.25 0.69 1.04 1.29 1.74 2.16 2.59	0.49 0.75 0.93 1.25 1.54 1.76 1.87 0.55 0.84 1.04 1.40 1.74 2.00 2.15 0.61 0.93 1.16 1.56 1.93 2.25 2.45 0.69 1.04 1.29 1.74 2.16 2.59 2.86	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 2.71 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 3.06 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 3.39 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72 3.83	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 2.71 2.83 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 3.06 3.16 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 3.39 3.48 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72 3.83 3.90	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 2.71 2.83 3.09 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 3.06 3.16 3.42 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 3.39 3.48 3.71 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72 3.83 3.90 4.08	0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 2.71 2.83 3.09 3.28 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 3.06 3.16 3.42 3.61 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 3.39 3.48 3.71 3.91 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72 3.83 3.90 4.08 4.27	0.43 0.65 0.81 1.09 1.34 1.52 1.60 1.75 1.88 1.94 2.17 2.26 2.38 2.50 2.76 2.95 3.35 0.49 0.75 0.93 1.25 1.54 1.76 1.87 2.03 2.17 2.21 2.47 2.60 2.71 2.83 3.09 3.28 3.76 0.55 0.84 1.04 1.40 1.74 2.00 2.15 2.33 2.47 2.49 2.76 2.94 3.06 3.16 3.42 3.61 4.12 0.61 0.93 1.16 1.56 1.93 2.25 2.45 2.63 2.77 2.80 3.08 3.28 3.99 3.48 3.71 3.91 4.47 0.69 1.04 1.29 1.74 2.16 2.59 2.86 3.05 3.19 3.23 3.47 3.72 3.83 3.90 4.08 4.27 4.90 0.74 1.13 1.40 1.89 2.33 2.85 3.17 3.38 3.53 3.56 3.77 4.07 4.20 4.24 4.40 4.52 5.17

^{*}The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

**These precipitation frequency estimates are based on a partial duration maxima series, ARI is the Average Recurrence Interval.

Maps -



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; USGS Aerial Photograph may also be available

from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the <u>National Digital Orthophoto Program (NDOP)</u> for more information.

Watershed/Stream Flow Information -

Please refer to the <u>documentation</u> for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information

about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,

please refer to our documentation.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (32.84/-113.23). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center DOC/NOAA/National Weather Service 1325 East-West Highway Silver Spring, MD 20910

(301) 713-1669 Questions?: HDSC.Questions@noaa.gov

Disclaimer

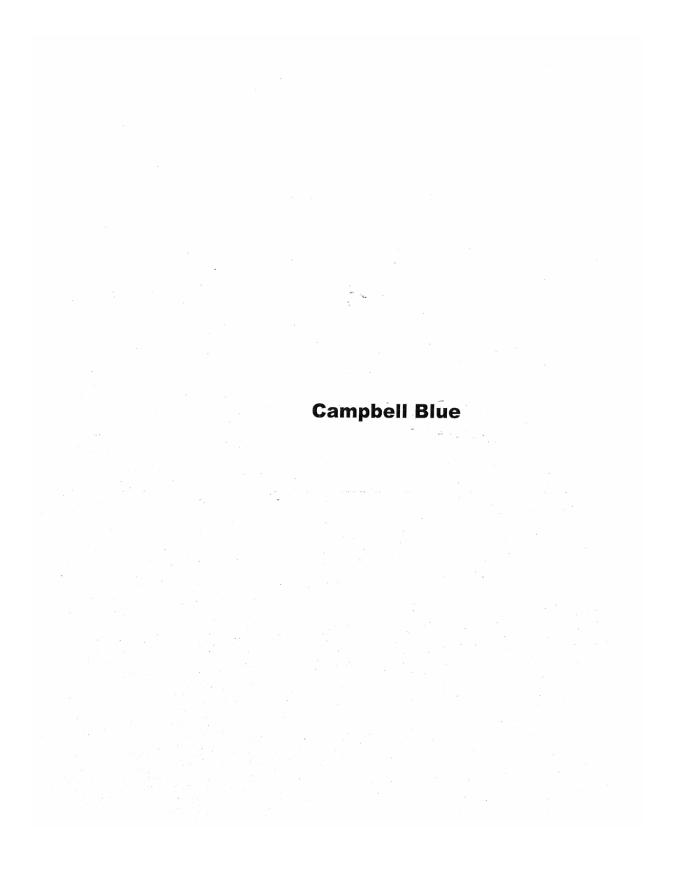
Green Ampt Paramete

	(sector)	(sectors) (segmilian)	Soil	Texture	Ans jacres	×		XXSAT Composite XXSAT DTHETA PSIF Adjusted XXSAT Impervious (%) Initial Loss (Inches)	DTHETA	PBF	Adjusted XKSAT	Impervious (%)	Initial Loss (inches)
Dasin 1	1805	2.820	Chertoni-Costidge Complex	sandy loam	1672	80%	0.4						
			Clariano-Hyder-Rack Outcrap Complex	sandy loam	22	É	0.4						
			Coolidge Complex	mendy loans	28	ĸ	2						
					1806	2001		0.40	8	6	0.40	8	0.15
Basin 2	400	1.655	Cheriori-Coolidge Complex	sandy loam	388	12	2						
			Coolege Complex	nandy loam	R	27%	2						
								0.40	0.36	4.3	0.40	8	81.0
					1050	100%							
Bash 3	1625	2,539	Cherieni-Cookidge Complex	sandy loans	191	425	0.4						
			Coolidge Complex	sandy loam	1428	N/00	0.4						
								1	1	1		1	
					1025	100%		7	9	7	040	ş	g g
Basin 4	749	1170	Cherteri-Coolidge Complex	marrdy loans	8	No.	9.4						
			Opriano-Hyder-Rock Outerap Complex	sandy loan	26	£	4.0						
			Coolidge Complex	sandy loam	\$	£	0.4						
								0.40	0.35	2	0.40	8	0.15
					740	100%							
Basin 5	230	0.422	Cheriori-Coolidge Complex	sandy loans	222	8538	0.4						
			Coolidge Complex	sandy loam	\$	10%	0.4						
										8	-	5	
					270	100%			600	2	0.40	ŝ	6

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	Tc (hrs) 1.08	0.89	1.08	0.78	0.39	1.70
	Impervious (%) 20	20	50	20	20	20
ers	Slope (ft/ft) (ft/mile) 0.008 39.6	6.69		55.3	170.0	32.1
shed Paramet	Sic (ff/ft) 0.008	0.013		0.010		900.0
Natural Watershed Clark Unit Hydrograph Parameters	Length to Centroid (ft) (miles) 7989 1.513	1.658	1.558	1.361	1.124	2.86
Clark Un		8754	8226	7186	5935	15101
	Length (ft) (miles) 17598 3.333	2.375	3.592	1.717	0.353	6.193
	(ft) 17598	12540	18966	9906	1864	32699
	sa (sq mi) 2.820	1.655	2.539	1.170	0.422	8.606
	Area (acres) 1805	1059	1625	749	270	2208
	Basin 1	2	ဗ	4	2	ALL

	Peak rrge)	3300
Results	100-year Peak Discharge (cfs)	
HEC-1 Results	Drainage Area (sq mi)	9 .
	P 3 year Peak Discharge (cfs)	2100
	LP 3 year F	
Jata	Period of Record	8
USGS Data	Drainage Area (sq mi)	7.89
		Sentinel, AZ
	Station Name	Military Wash near Sentinel, AZ



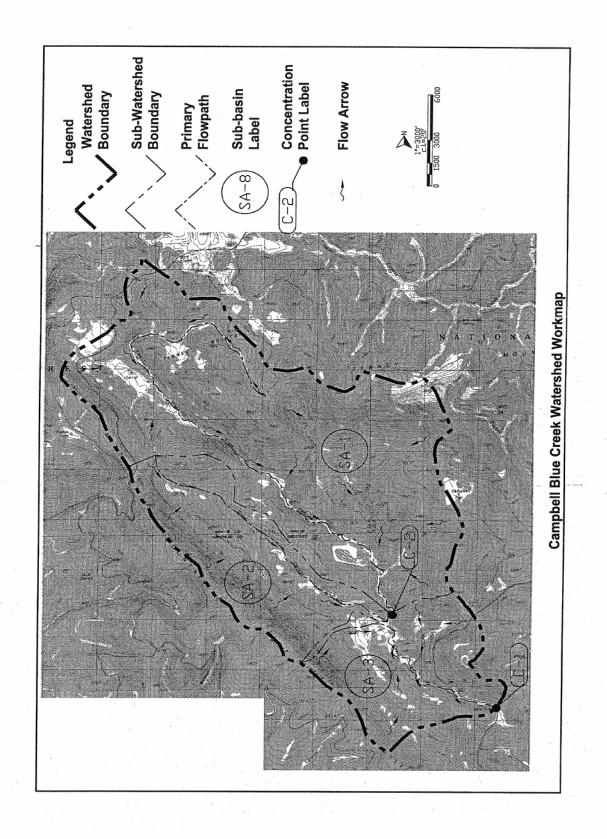
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	U.S. ARMY CORPS OF ENGINEERS HYDROLOGIC ENGINEERING CENTER 609 SECOND STREET DAVIS, CALIFORNIA 95616 (916, 756-1104	* * * * * *				CTURE.									
e	OF ENG: EERING STREE? PRNIA 99	* * *			w.	T STRUC VERSIC	PAGE 1								
	CORPS C ENGIN SECONI CALIFO	* * * *) HEC1K	LE INPU RTRAN77 SQUENCY	PA	0							
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	* * * * * *	× *			ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HECI (JAN 73), HECIGS, HECIDB, AND HECIKM.	F VARIABLES -FILMP- AND -FILOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTUREAASKE, ON RA-CAND MAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRANTY VERSION TERA OUTSIGN SOTHERWAY SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STRAGE FREQUENCY, SER AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION		8	LON						
			* × × ×	×××	AN 73)	OSE US 28 SE LATION		7	GAGE STATION	(Q			2.81		
			XXXXX		HEC1 (5	FROM TE S DATEI E CALCU TE:GREE	•	9	AT	(ADOT METHOD)	ACTOR,	• * .	- `		
			XXXXX X X X X	XXXXX	DWN AS	HANGED EVISION F DAMAG		:	CREEK,	T (ADO	REDUCTION FACTOR,		2.67		
	- *		XXX	XXXXXXXX	C-1 KN	HAVE CI WITH RI LE EVENT	HEC-1 INPUT	5	TEST WATERSHED CAMPBELL BLOG, 3 MILES ABOVE COLEMAN CREEK, JE FULLER HYDRO AND GEOM BY IAM SHARP MAY, 2006	AND AMI	4 REDUC		2.35		
					S OF HE	RTIOR- HANGED , SINGI N INTER	HEC-1	4	ABOVE C	GREEN	AZ (0.6	300	1.41		
			× × × × × × × × × × × × × × × × × × ×	***	ERSION.	- AND		33	MILES AND GEON	MODEL, DAT	NTRAL		0.75		
	* * * * * * 4	*			VIOUS V	-RTIMP- RM-CARI SUBMEH ED CALC		2	SHED LUE, 3 HYDRO P	3-HOUR BLUE03.	3HR, CE	00			
	(HEC-1) C-1.COM	* * *			ALL PRE	IABLES KK- ON OUTFLOW T DESIR		13.	r WATER PBELL B FULLER FAN SHA	-YEAR,	30-40,				
	Ω	***				OF VAR DE -AMSI BREAK (BRIES A' NEW FII		ID	CAMI JE I BY I	FILE	ID HYDE *DIAGRAM	,, ,			
	PACKAG1 1998 4.1 6 TIME	* * *			RAM REP	ITIONS ITION C NS: DAN TIME SE WAVE:		IL	99999	日日	H *	i o f	PH		
	FLOOD HYDROGRAPH PACKAGE UDM 1998 VERSION 4.1 ECHHEC2000 IUN DATE 30MAY06 TIME	*******			THIS PROGRAM REPLACES	THE DEFINITIONS OF VARIABLES -RTIMP- THE DEFINITION OF "AMSKE-ON RM-CARD NEW OFFLOWS: DAMBREAK OUTFLOW SUBMERS DISS: READ TIME SERIES AT DESIRED CALCU KINEMATIC WAVE: NEW FINITE DIFFERENCE									
į.	FLOOD HYDE V RGMHEC2000 RUN DATE	**			THI	THE NEW DSS		LINE	12643	91	ω	100	175		
	FLO	* * *													

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	0 0 0	12	0.0073 760 0	0 112	NPUT	ATION	
ASIN 1	0.48 8 3ASIN 2 0.48	ω	10940 0. 620	SA-3 CAMPERELL BLUE CREEK SUB-BASIN 3 2.66 0.75 0.25 3.5 0.48 1.20 0.67 1.00 3 5 8	HEC-1 INPUT	E RC-1 AND SA-3 AT GAGE STATION	
SUB-Bi	3.5 (5 5 5 5 5 5 5 6 8 8 8 8 8 8 8 8 8 8 8 8	2 2	-1 0.04 10 560	SUB-BA	. e	-3 AT 0	
CREE	CREE	AND SA	C-2	CREEK		AND SA	
נד פרתו	0.25 1.45 3 3 6.25 0.25	E SA-1	C-1 TO C-2 FLOW 0.04 530 20	GL BLUE 0.25 0.67		3 RC-1	
SA-1 CAMPBE 9.28	SA-2 CAMPBE 3.04 0.75	0 3 5 100 C-1 COMBINE SA-1 AND SA-2	RC-1 ROUTE 5 0.06	SA-3 CAMPBE 2.66 0.75 1.20 0	1	2 1 2	
* XX XX KM KM	LG UA WA KK KK KK UG UC			KK KM BA LG UC UA *	ID	KW * HC	
113	114 117 122 223 24	25 26 27 28 29	30 31 32 33 34 35	36 37 38 39 40 41	LINE	43	

		* U.S. ARMY CORPS OF ENGINEERS * * HYDROLOGIC ENGINEERING CENTER * 609 SECOND STREET * * DAVIS, CALIFORNIA 95616 * * (916) 756-1104 * ***********************************	
1 SCHEMATIC DIAGRAM OF STREAM NETWORK LINDT LINE (V) ROUTING (>) DIVERSION OR PRIOR	(.) CONNECTOR (< SA-1 C-1 V V V RC-1	43	TEST WATERSHED CAMPBELL BIUE, 3 MILES ABOVE COLEMAN CREEK, AT GAGE STATION DE FULLEN HYRO AND GEOM BY LAN SHAP MAY, 2006 100-YEAR, 3-HOR HODEL, GREEN AND AMPT (ADOT METHOD) FILLE NAME BILDO3.DAT HYDRO-40, 3HK, CENTRAL AZ (0.64 REDUCTION FACTOR) 10 IO OUTFUT CONTRO! VARIABLES

					.03 .03 .02		MAXIMUM TIME OF STAGE MAX STAGE					
					.02 .02 .16 .35 .03 .03	LES	BASIN AREA	47. 9.28	15. 3.04			
SOALE	MINUTES IN COMPUTATION INTERVAL STRATING DATE STRATING TIME NUMBER OF HYDROGRAPH ORDINATES ENDING DATE ENDING TIME CENTURY MARK		ND	DEPTH DRAINAGE AREA	.01 .01 .01 .09 .09 .04 .03 .01	RUNOFF SUMMARY FLOW IN CUBIC FEET PER SECOND TIME IN HOURS, AREA IN SQUARE MILES	AVERAGE FLOW FOR MAXEMUM PERIOD 6-HOUR 24-HOUR 72-HOUR	189. 49.	64. 16.			
5 PRINT CONTROL 0 DLOT CONTROL 0 HYDROGRAPH FROL 0 HYDROGRAPH FOR SCALE	DATA 5 1 0000 2 0055 19 19	INTERVAL .US HOURS IME BASE 24.92 HOURS	SQUARE MILES N FEET CUBIC FEET ACRESFEET ACRES	1.80 PRECIPITATION DEPTH 14.98 TRANSPOSITION DRAINAGE AREA	N PATTERN .01 .01 .01 .02 .04 .07 .08 .07 .07 .07 .07 .01 .01 .01 .01	FLOW I	PEAK TIME OF N FLOW PEAK	.1 501. 3.58	.2 269. 2.75			
IPRNT IPLOT QSCAL QSCAL	HYDROGRAPH TIME NATN IDSTE ITIME INDTE NDTTME ICENT COMPUTANTON T	COMPUTATION INTERVAL TOTAL TIME BASE	ENGLISH UNITS DRAINFOR ARRA PRECIPITATION DEPTH LENGTH, ELEVATION FLOW STORAGE VOLUME SURFACE AREA TEMPERATURE	INDEX STORM NO. STRM TRDA	PRECIPITATION 01 03 14 02		OPERATION STATION	HYDROGRAPH AT SA-1	HYDROGRAPH AT SA-2	2 COMBINED AT		
	E H			11 JD	12 PI	⊣	+	+	+			

	6/ 5	
	0	
,	2	
12.32	2.66	
12	14	
63.	14.	
65.	14.	
252.	56.	
3.42	3.67	
643.	302.	
C-1	SA-3	
	AT AT	** **
ROUTED TO	HYDROGRAPH AT 2 COMBINED AT	*** NORMAL END OF HEC-1 ***
		NORM!



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		. Foss	a a a	cy.	a, a,	so.	22 22									
		Initial Loss	0.75	0.75	0.75	0.75	0.75	0.75								
		. sn														
		Impervious (%)	00	0	0 0	0	00	0								
			1													
		Adjusted XKSAT	0.30	0.30	0.30	0:30	0.30	0.30								
,		Adius	,											~	-	
		PSF	8, 8, 75, 75	8. 13.	8, 8, 70, 70,	3.5	6. 6. 6. 6.	3.5								
			II .	0.25	0.25	0.25	0.25	0.25								
		XKSAT Composite XKSAT DTHETA		0	00	0	00	0								
		ite XKS	0.25	0.25	0.25	0.25	0.25	0.25								
		Сотрое		,	0.0			, •			-					
	shed	CKSAT	0.25	0.25	0.25	0.25	0.25	0.25		-						
	Natural Watershed Green Ampt Parameters	. ^	95%	Composite Value 0.25		9	40%	Composite Value 0.25	4.0		• .					
	Natur Green A			mposite	. 12%	mposite		mposite								
		Area (acres)	5,643	ŭ	2,024 276	ŏ	832	ŏ.								
			-								· 4					
		je je	ly Loam m		m ly Loam		n ly Loam									
		Texture	Very Cobbly Loam Loam		Loam Very Cobbly Loam	-	Loam Very Cobbly Loam									
			>		>		š									
			,													
		Soil	198		168	168	198									
		l Area (sq miles)	9.28		3.58	3.24										
		Watershed Area (acres) (sq mil	9		0	0	2									
		Wacn (acn	5940		2300	2080										
		.	pell-1		Campbell-2	Campbell-3							-			
			Campbell-1		Camp	Camp										
		•														

					1 of 1
	ĸ	1.45	0.87	0.67	
	Tc (hrs)	2.51	1.53	1.20	
	Impervious (%)	0	0	0	
હ	Slope (ff/mile)	122	180	346	
shed n Paramete	Sic (ff/ff)	0.023	0.034	0.066	
tural Water Hydrograpł	Centroid (miles)	3.05	1.89	1.41	
Natural Watershed Clark Unit Hydrograph Parameters	Length to Centroid (ft) (miles)	16,200	10,000	2,500	
	lth (miles)	7.52	3.58	3.24	
	Length (ft) (mi	39,800	18,900	17,100	
	a (sq mi)	9.28	3.04	2.66	
	Area (acres) (s	5,940	1,950	1,710	
	Basin	Campbell-1	Campbell-2 1,950	Campbell-3 1,710	

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	Velocity (ff/sec)	∞		
Routing Parameters	Slope (ff/ft)	0.0073		the state of the s
ing Pa				
	gth	10940		
	Length (ft)	, 100		
	teach			
	Routing R	RC-1		
	Watershed Routing Reach	Blue		

	I	ak	
		100-year Peak Discharge (cfs)	069
	sults	00-yea Disch (cl	8
	HEC-1 Results	ğ. 5	
	넴	Drainage Area (sq mi)	86
		ainag (sq I	14.98
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		harge	6.
		Disc	
		LP 3 100-year Peak Discharge (cfs)	299
	1	-year	
ults	.	100	
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Comparison of Results		Scord	
ıparis		of Re	6
Com		Period of Record	
	ata	<u>~</u>	
	USGS Data	. 00	
	ns	Drainage Area (sq mi)	6
	.	ainag (sq	~
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		. We	gine
		Station Name	Campbell Blue
		Static	di Bo
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